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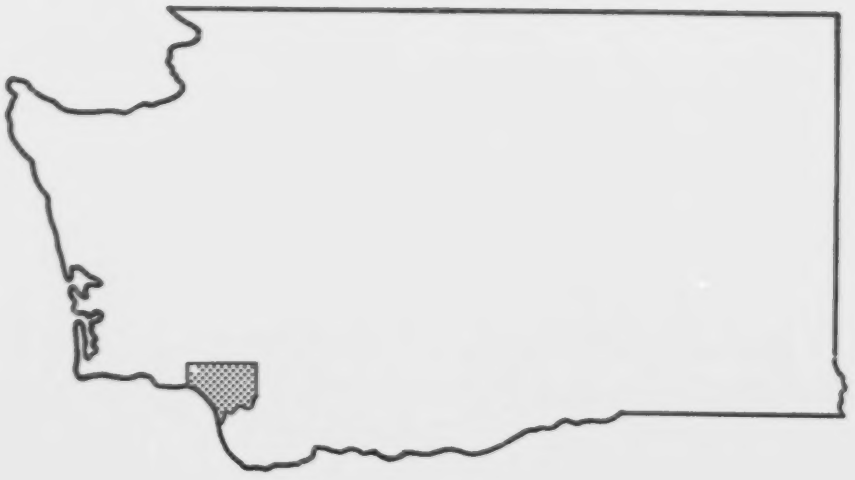
FLOOD INSURANCE STUDY

COWLITZ COUNTY, WASHINGTON
UNINCORPORATED AREAS



SEPTEMBER 29, 1989

Federal Emergency Management Agency

COMMUNITY NUMBER - 530032

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

This publication incorporates revisions to the original FIS. These revisions are presented in Section 9.0.

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Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the unincorporated areas of Cowlitz County, Washington, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Cowlitz County to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The identification of streams selected for detailed analysis was accomplished in a meeting held on April 14, 1976, attended by representatives of the Federal Insurance Administration, the county, and the study contractor who was initially selected to perform the study but not subsequently brought under contract. A later meeting attended by representatives of the Federal Insurance Administration, the county, and the finally selected study contractor was held on July 6, 1976.

During the course of the work, numerous informal contacts were made by the study contractor with the county for the purpose of obtaining data and acquiring base map material.

On April 24, 1979, the results of the work were reviewed at an Interim Technical Meeting attended by representatives of the Federal Insurance Administration, Cowlitz County, and the study contractor.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Comany, for the Federal Insurance Administration, under Contract No. H-4025. This work, which was completed in June 1979, covered all significant flooding sources affecting Cowlitz County.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Cowlitz County, Washington. The area of study is shown on the Vicinity Map (Figure 1).

The incorporated areas of the Cities of Kelso, Longview, Castle Rock, and Woodland, and the Town of Kalama, Washington, were not included in this study.

The following streams were studied by detailed methods:

Stream	Detailed-Study Segment (River Miles)
Columbia River	56.0 - 77.8
Mill Creek	0.0 - 3.9
Abernathy Creek	0.0 - 5.9
Germany Creek	0.0 - 5.5
Coal Creek	0.4 - 6.6
Harmony Creek	0.0 - 2.1
Coweman River	11.4 - 18.4
Goble Creek	0.0 - 2.3
North Fork Goble Creek	0.0 - 1.7
Ostrander Creek	0.0 - 1.9
South Fork Ostrander Creek	0.0 - 0.9
Arkansas Creek	0.0 - 4.6
Delameter Creek	0.0 - 3.0
Monahan Creek	0.0 - 0.3
Kalama River	0.0 - 19.8
Lewis River	0.0 - 19.1

Several streams in areas of little or no development, in addition to several streams designated by the Federal Insurance Administration, were studied by approximate methods. They are:

Stream	Approximate-Study Segment (River Miles)
Slide Creek	0.0 - 1.5
Falls Creek	0.0 - 1.5
Arkansas Creek	4.6 - 6.4
Baxter Creek	0.0 - 0.6
Outlet Creek	0.0 - 2.7
Olequa Creek	0.0 - 2.0
Leckler Creek	0.0 - 3.4
Schoolhouse Creek	0.3 - 1.3
Creek at Esoh Road	0.0 - 1.3
Owl Creek	1.1 - 3.7
North Fork Owl Creek	0.0 - 0.5
Fish Pond Creek	0.7 - 1.9

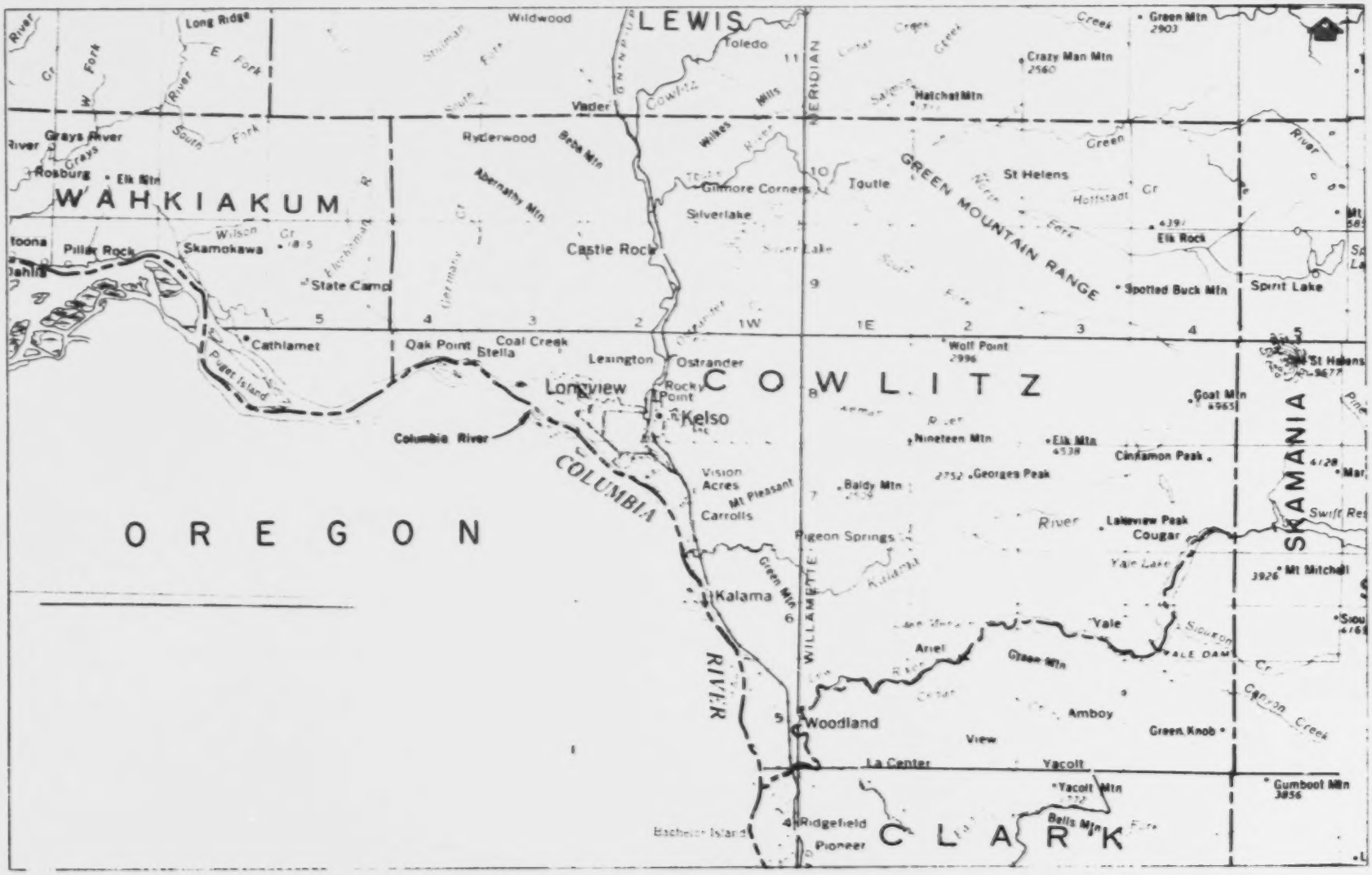

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

8 0 8 16 24 MILES

VICINITY MAP

Stream	Approximate-Study Segment (River Miles)
Little Kalama River	0.0 - 4.0
Ostrander Creek	1.9 - 3.4
Coweman River	0.0 - 11.4
	18.4 - 28.1
Lewis River	31.3 - 33.9
	44.0 - 44.9
Columbia River	51.5 - 56.0
	77.8 - 87.0
Cowlitz River	0.0 - 26.6
Toutle River	0.0 - 17.2
North Fork Toutle River	0.0 - 32.8
South Fork Toutle River	0.0 - 2.7
McCorkle Creek	0.0 - 0.6
North Fork McCorkle Creek	0.0 - 0.3

Initially, Cowlitz River, lower Coweman River, Toutle River, North Fork Toutle River, South Fork Toutle River, McCorkle Creek, and North Fork McCorkle Creek were studied by detailed methods. However, due to the eruption of Mount St. Helens, it was decided by the Federal Insurance Administration to study and delineate these areas by approximate methods, with the intention that a detailed study will be made of these streams at a later date.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1984.

2.2 Community Description

Cowlitz County is in southwestern Washington on the north bank of Columbia River. It is approximately midway between the mouth of Columbia River and the City of Portland, Oregon. Cowlitz County covers an area of 1144 square miles and is bordered by Lewis County, Washington, to the north; Skamania County, Washington, to the east; Clark County, Washington, to the southeast; Columbia County, Oregon, to the southwest; and Wahkiakum County, Washington, to the west.

Cowlitz County was one of the first areas to be settled in the state. The first settlers migrating overland from the east arrived in 1844. In 1854, the first session of the Washington Territorial Legislature established eight counties, one of which was Cowlitz (Reference 1). The earliest community to be incorporated in the county was Kalama in 1871. This community was only the seventh in the state to be incorporated (Reference 2). Kalama was the original county seat; Kelso became the county seat in 1922. Population growth in the county was steady prior to 1910 (5,900 in 1980; 8,000 in 1900; 10,300 in 1910), but it then leveled off until the early 1920s. At that time, the Long Bell Lumber Company of Wisconsin constructed what was then the largest lumber mill

in the world and established Longview as a planned model city. The mill began operation in 1924, and was followed in 1929 by the Weyerhauser facility. The effect was to boost the county population to 32,000 by 1930, from whence it has risen steadily to an estimated 70,700 by 1975 (Reference 3).

Forest products provide the mainstay of the economy of Cowlitz County with 37.2 percent of wage and salary earners employed in lumber and the manufacture of wood products, paper, and allied products (Reference 4). The volume of timber harvest is the largest of any county in the state. The 1974 total of 729 million board feet represented 10.6 percent of the state total (Reference 4). Although forest products and allied industries (such as chemical plants producing plywood adhesive and paper-bleaching compounds) are predominant in the economic base, a number of other industries make an important contribution. Among these are aluminum smelting and the manufacture of pleasure boats and mobile homes. Agriculture is confined to 70 square miles of farmland, on which dairy and poultry products are predominant.

There is generally only minor residential development along some of the Cowlitz County flood plains. Other flood plains have no development within the county.

Drainage within Cowlitz County is southerly and westerly to Columbia River. (A 5-square-mile area in the northwestern corner of the county is in the catchment of Chehalis River in Lewis County.) The principal river systems are described as follows:

Columbia River

Upstream of the Wahkiakum/Cowlitz County limits at River Mile 52.0, Columbia River drains approximately 256,000 square miles on the western slope of the Continental Divide in the northwestern part of the United States and southwestern Canada. Major parts of the States of Washington, Idaho, and Oregon, and small parts of the States of Montana, Wyoming, Utah, and Nevada, in addition to southeastern British Columbia, are within the Columbia River drainage basin.

The basin terrain varies from flat or gently rolling farmland to high, rugged, wooded mountains. The watershed boundaries throughout the basin are a series of rugged mountains. The highest elevation in the basin is 13,766 feet, and the average elevation of the basin is approximately 4,200 feet. The total fall of Columbia River from the Canadian border (River Mile 745.0) to the mouth is 1304 feet, or an average fall of 1.75 feet per mile. Within the study area, Columbia River has an average fall of 0.3 foot per mile at flood stage. At low water, tides reverse the slope of the river during a 24-hour period (Reference 1).

Cowlitz River, Coweman River, Toutle River

Cowlitz River flows into Columbia River at River Mile 68.0, and its principal tributaries within Cowlitz County are Coweman River (River Mile 1.3) and Toutle River (River Mile 20.3).

Coweman River (also spelled "Coweeman"), with a drainage area of 127 square miles at its mouth, joins Cowlitz River at River Mile 1.3. The stream flows westerly from its source on the northwestern slopes of Elk Mountain (at an elevation of 4538 feet). The headwaters section of the drainage basin is mountainous, and the streams flow through canyons with steep, rugged sides. High benches of comparatively level land exist in the middle and lower sections of the basin. The width of the valley through the study segment averages 1 mile. The widest flood plain is in the vicinity of Kelso, Washington.

The entire watershed is within Cowlitz County and is kidney shaped, 25 miles long, and 8 to 10 miles wide. Only a small portion of the area is devoted to agricultural or related uses.

The topography of the watershed is mountainous and rugged. The highest elevation in the basin is 4538 feet, and the average elevation is 1230 feet. Above River Mile 30, the river has a gradient greater than 100 feet per mile. Between River Mile 30 and River Mile 9, the gradient flattens from approximately 40 feet per mile to 25 feet per mile. Below River Mile 7, the gradient is less than 3 feet per mile.

Within Cowlitz County, two other major streams enter Cowlitz River from the west. Olequa Creek drains an area south of Winlock in Lewis County and to the south of Ryderwood in Cowlitz County. It has a total drainage area of 108 square miles, of which 27 square miles is within Cowlitz County. The stream has a gradient of 25 to 40 feet per mile between Winlock and Vader, flattening to 15 to 20 feet per mile toward the mouth.

Cowlitz River is also joined by Arkansas Creek. This stream and its tributaries, the principal of which is Delameter Creek, drain an area of approximately 48 square miles entirely within Cowlitz County. In the segment 5 miles upstream of the mouth of Arkansas Creek, the slope flattens from more than 100 feet per mile to less than 10 feet per mile.

Kalama River

Kalama River, with a drainage area of 205 square miles at its mouth, joins Columbia River at River Mile 73.0. The watershed is rectangular in shape, 30 miles long and 6 miles wide. Nearly all of the drainage area is in Cowlitz County. The stream flows westerly from its source on the southwestern slope of Mount St.

Helens and joins Columbia River approximately 2 miles north of the Town of Kalama. Topography of the watershed is mountainous. Ridges are well defined, rugged, and forested. The average elevation of the basin is 1880 feet.

Canyons in the headwaters are steep and rugged. High benches of comparatively level land exist in the middle and lower sections. The fall averages 215 feet per mile over the entire length of the river. Toward the mouth, the gradient flattens; below River Mile 8, the fall averages 10 feet per mile; from River Mile 8 to River Mile 20, 30 feet per mile.

Lewis River

Forming the boundary between Cowlitz and Clark Counties, Lewis River, with a drainage area of 1046 square miles at its mouth, flows into Columbia River at River Mile 87.0. Approximately 25 percent of the total drainage area is in Columbia National Forest, and 10 percent of the total drainage area lies in Cowlitz County. The stream flows southwesterly from its source on the northwestern slopes of Mount Adams and is joined by East Fork Lewis River at River Mile 3.5, approximately 3 miles south-southwest of the City of Woodland. The watershed is boot shaped, 40 miles long, 30 miles wide at the downstream end, and 15 miles wide at the upstream end. A small portion of the basin is used for agricultural or related purposes.

Topography of the basin is mountainous, and the watershed divides consist of rugged, well-defined ridges. The highest elevation in the basin is 12,307 feet (Mt. Adams); average elevation is 2,360 feet. High benches of comparatively level land are in the middle and lower sections of the basin.

The total fall of Lewis River from its headwaters to its junction with Columbia River is 7900 feet, an average of 112 feet per mile. In the 20-mile segment between the mouth and Lake Merwin Dam, Lewis River has an average fall of 2 feet per mile, and an average valley width of 1 mile. Reservoirs have been created along the main stem of the river by dams located approximately at River Mile 20 (Merwin Lake), River Mile 34 (Yale Lake), and River Mile 47 (Swift Reservoir).

Significant tributaries to these principal river systems of Cowlitz County are Monahan Creek, Ostrander Creek, South Fork Ostrander Creek, Goble Creek, North Fork Goble Creek, Harmony Creek, Coal Creek, Germany Creek, Abernathy Creek, and Mill Creek.

The climate in Cowlitz County is influenced by the flow of air along the Columbia River valley. Average annual precipitation ranges from 40 inches near Columbia River to 90 inches at the 1000-foot elevation in the Cascade Range foothills. Annual snowfall is in the range of from 10 to 50 inches at lower elevations and as much as 250 to 350 inches in the upper Cascade Range. In the fall, freezing temperatures can be expected after the middle of October, with minimum winter temperatures of from 5°F to 10°F. In the spring, the last freezing temperatures can be expected

in mid-April in the lower valleys and mid-May in the colder localities. Maximum July temperatures average from 75°F to 80°F, but have occasionally reached from 100°F to 105°F, generally during periods of dry easterly winds (Reference 5).

2.3 Principal Flood Problems

Major floods usually result from a combination of intense rainfall and snowmelt after the watershed has been saturated from prior rainfall. Columbia River floods generally are an annual event which occurs in the spring when the snow melts in the mountains. However, there has been winter flooding through the study reach of magnitudes comparable with the larger spring freshets.

Flooding from rivers and smaller creeks within the Cowlitz, Kalama, and Lewis River basins generally occurs during the winter months of November through January.

The historical record of flooding in Cowlitz County is available only for the period since substantial population centers became established. In December 1933, the county experienced one of the worst and most extensive floods in memory when Cowlitz, Coweman, Kalama, and Lewis Rivers peaked well in excess of their current estimated 100-year discharge. Damage to the area was estimated at more than $3 million, occurring mainly within the populated urban centers of Kelso, Castle Rock, and Woodland when protective dikes were washed out and nearly 3000 people were forced to evacuate their homes because of the high water. Several major bridges were destroyed, and considerable damage to rural highways and farmland was incurred. In June 1948, Columbia River swelled to a peak discharge of more than 1 million cubic feet per second and caused an estimated $7.2 million damage, $6 million of which was to farm property, in the region from Woodland to Willow Grove. Flooding was intensified by high tides which affected Columbia River elevations within Cowlitz County. The largest flood on Columbia River in recorded history occurred on June 7, 1894. The following is an excerpt from the Cowlitz County Historical Quarterly, Volume 2, No. 4, p. 9:

> The floods of 1876 and 1884 had been bad but the flood of 1894 forced the vacating of all the business district and steamboats came up the streets of Kalama. The railroads were all under water and the ferry "Tacoma" was loaded with passenger cars to meet the trains at Kelso and transport the passengers direct to Portland. Business was carried on in private homes and in tents. Houses could be seen floating down the river and anxiety ran high as to whether the town's business district could withstand the strain. When the water finally subsided the grade level of the railroad was raised to its present level. In 1918 the dredges filled in the whole Kalama area to a high level with silt from the Columbia.

During spring floods, Columbia River remains above flood stage for from 30 to 90 days, while the winter flood-stage periods are of much shorter duration (Reference 1). Flood stages which have been recorded on Columbia River since 1858 were correlated with discharges at The Dalles (River Mile 119.0) which have been recorded since 1878. The following table lists peak discharges at The Dalles stream gage and corresponding water-surface elevations at Kalama and Longview for six major floods on Columbia River (References 1 and 6). For the winter flood of 1964, the peak discharge listed is not representative of flow at Kalama or Longview because of large inflows below The Dalles.

Date	Peak Discharges (Cubic Feet per Second)	Water-Surface Elevations At Kalama	At Longview
June 7, 1894	1,240,000	27.6	23.8
June 1, 1948	1,010,000	24.0	20.7
June 24, 1876	958,000	23.5	20.5
December 24, 1964	364,000	21.4	18.6
June 4 and 5, 1956	823,000	20.7	17.7
June 19, 1933	722,000	19.5	16.5

The largest flood on Kalama River occurred in December 1933. During that flood, it is estimated that velocities in the channel in the vicinity of Kalama reached 15 feet per second, with overbank velocities up to 6 feet per second (Reference 1). The following are peak discharges and corresponding elevations below Italian Creek for the six largest recorded floods on Kalama River:

Date	Elevation	Estimated Peak Discharges (Cubic Feet per Second)	Approximate Recurrence Interval (Years)
December 23, 1933	49.1	45,000	--[1]
January 20, 1972	37.5	17,900	15
December 12, 1977	37.0	16,900	10
November 20, 1962	37.0	16,600	10
November 23, 1942	36.7	16,250	9
December 9, 1953	36.7	16,000	8

[1]Not Available

On Lewis River, the largest flood in recorded history occurred in December 1933. During that flood, the river rose at an average rate of 0.2 foot per hour for 48 hours and remained above bankfull stage for 30 hours. During the flood of November 1962, the third largest flood of record, the river rose at an average rate of 1.5 feet per hour for 9 hours as a result of opening the spillway gates at Ariel Dam. A maximum rate of 6 feet per hour was experienced during that rise, and the river remained above bankfull stage for 18 hours (Reference 1).

The following is a list of peak discharges and corresponding elevations at the Ariel gage for six major floods on Lewis River:

Date	Elevation	Estimated Peak Discharges (Cubic Feet per Second)	Approximate Recurrence Interval (Years)
December 22, 1933	79.0	129,000	240
December 18, 1917	70.5	81,500	25
November 20, 1962	69.7	75,500	19
December 13, 1946	68.0	67,300	13
December 4, 1975	66.6	64,500	11
November 25, 1927	66.2	62,600	9

Although there was widespread flooding throughout Cowlitz County in 1964, 1972, 1975, and 1977, very little damage to major urban areas was incurred. Nevertheless, damage to county highways and bridges, and to telephone and electrical services could cause considerable loss of income and inconvenience to those urban areas which would be cut off and isolated for any length of time. Domestic water-intake structures and sewage treatment plants located in the flood plain would be subject to damage if large amounts of heavy debris were transported by floodwaters. In the rural areas, the prime concern is damage to farmhouses and machinery, cattle and other livestock, and isolated residences within the flood plain. Damage to crops and the erosion of prime topsoil from agricultural land could result in extensive, long-term economic loss. Many low-lying areas which are protected by levees from riverine flooding may be subject to shallow ponding of interior runoff which cannot escape through normal drainage channels. This situation could be very acute in residentially developed lowlands where there is no provision for storage and pumping out of excess runoff. Figures 2 through 5 show the results of flooding in Cowlitz County for the floods of 1948, 1964, and 1975.

2.4 Flood Protection Measures

The reduction of damage in major urban areas during the 1964, 1972, 1975, and 1977 flooding was due in part to dams and other flood-control structures constructed since the devastating 1933 and 1948 floods, including an extensive levee system designed to provide protection against 500-year flooding. Levee projects have been completed at various locations along Coweman, Lewis, and Kalama Rivers. More than 50 storage projects which have a significant effect on 100- and 500-year flooding in Cowlitz County exist on Columbia River and its tributaries. It is estimated that the 1948 flood could be regulated at The Dalles to 620,000 cubic feet per second under present regulatory conditions. Further protection is provided by numerous bank protection and levee projects maintained by the Cowlitz County Consolidated Diking Improvement District No. 1 (C.C.C.D.I.D. No. 1) in the Longview-Kelso area. Some of these levees were constructed entirely by local interests. Others were either constructed or improved with Federal funds in cooperation with local interests.

Figure 2. Ostrander Creek Flood Stage, December 1975, in Area Immediately Upstream of Interstate Highway 5

Figure 3. Flooding at Camp Kalama From Kalama River and Columbia River Backwater, December 1964

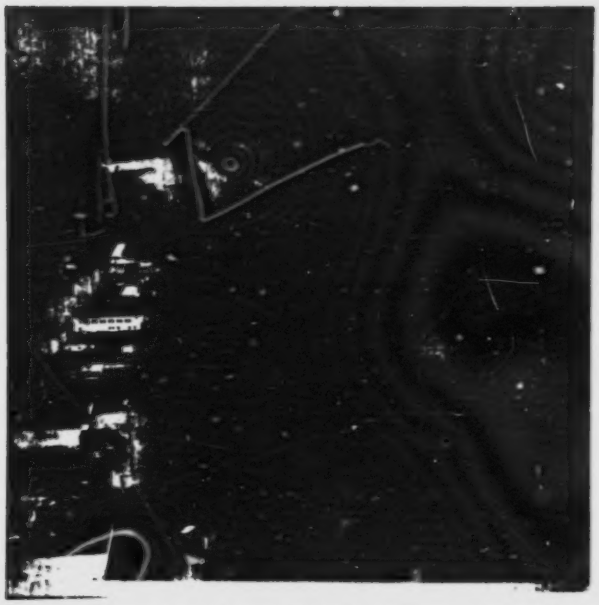

Figure 4. Columbia River Flood Stage, December 1964, at River Mile 75 (Photograph Taken Looking Downstream With Town of Kalama and Interstate Highway 5 at Right of Picture)

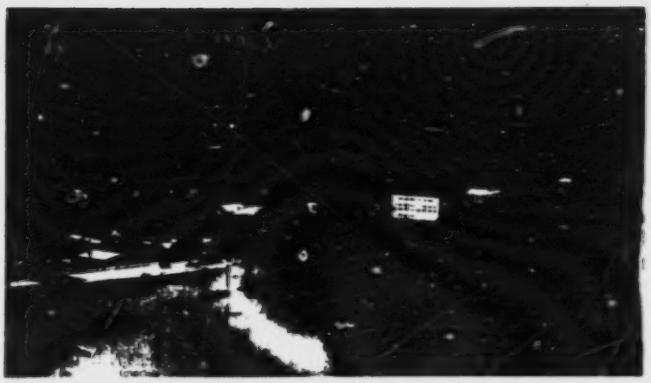

Figure 5. Flooding Through the Town of Kalama From Columbia River, June 1948

No flood regulation is provided by the three power projects on Lewis River. They are operated exclusively for power generation.

Portions of the flood plain of Coweman River are within Flood Control Zone No. 14 (Cowlitz), and the lower segment of Lewis River is within Flood Control Zone No. 15. These Flood Control Zones are established under Chapter 86.16 of the Revised Code of Washington. City and county governments are obligated to abide by the provisions of this statute and, under a 1973 amendment, may be authorized to administer it. Under the statute, permits must be obtained from the Washington State Department of Ecology for proposed developments within the flood plain. Such permits stipulate a permissible flood elevation, and are not issued if the proposed development is located within a floodway.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the county at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the county.

The stage-discharge relationship on Columbia River through the study area is influenced by ocean tides; thus, frequencies are more reliably determined for river stages than for discharges. Stage-frequency curves for seven locations on Columbia River between River Miles 50 and 123 were prepared using existing data (References 7 and 8) for fall, winter, spring, and summer flood seasons.

The fall and winter curves and spring and summer curves at each location were then combined by statistical methods to obtain combined stage-frequency curves. Those stage-frequency curves are the basis for the Columbia River water-surface profiles contained in this study.

Floodflow-frequency data for Coweman River and Kalama River were based on statistical analysis of discharge records at the following gaging stations maintained by the U.S. Geological Survey:

Stream Name	Location	Period of Record
Coweman River Near Kelso, Washington (Gage No. 142450)	3.4 Miles Southeast of Kelso High School	1950-1979
Kalama River Below Italian Creek	2.8 Miles Northeast of Kalama	1946-1979

Analyses were performed in accordance with standard log-Pearson Type III methods as outlined by the U.S. Water Resources Council (Reference 9). Adjustments to compensate for contributing drainage areas upstream and downstream from gages were made using a runoff-routing computer model incorporating design recurrence for 24-hour storm precipitation.

The 24-hour duration storm precipitation volumes for 10-, 50-, and 100-year return storm frequencies were obtained from the National Oceanic and Atmospheric Administration Atlas 2 (Reference 10). Precipitation volume for the 500-year storm was obtained by extending the Atlas 2 frequency curve on normal distribution probability paper. Rainfall intensity distribution patterns were based on precipitation gages located at Castle Rock, Cougar, and Longview.

Floodflow-frequency data for Lewis River were based on statistical analysis of discharge records at the following gaging stations maintained by the U.S. Geological Survey:

Stream Name	Location	Period of Record
Lewis River at Amboy, Washington (Gage No. 379)	5 Miles Northeast of Amboy	1912-1931
Lewis River at Ariel, Washington (Gage No. 142205)	0.5 Mile Downstream From Ariel Dam	1923-1979

Lewis River streamflow is affected by storage in Lake Merwin Reservoir and Yale Reservoir. Analyses were performed by the U.S. Army Corps of Engineers as part of the Clark County, Washington, Flood Insurance Study (Reference 11) and the U.S. Geological Survey for a Flood Insurance Study for the City of Woodland, Washington (Reference 12). The resulting frequency curves were made available and verified by independent analysis performed by the study contractor.

There were little or no streamflow data available for the remaining streams in Cowlitz County. Estimates for design discharges for these streams were derived from a combination of regional analyses using the aforementioned gages and the runoff-routing model previously described.

Peak discharge-drainage area relationships for each stream studied in detail are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams in the county were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the county.

Water-surface elevations for the streams studied in detail were computed through use of the U.S. Army Corps of Engineers HEC-2 step-backwater computer program (Reference 13).

Cross sections provided by Towill, Inc., were derived photogrammetrically. All bridges and culverts were surveyed to obtain elevation data and structural geometry. The U.S. Army Corps of Engineers, Portland District, had previously developed the physical data and determined loss coefficients used to derive step-backwater computer models for Columbia River (River Miles 62.4 to 67.2) and Lewis River (River Miles 0.0 to 14.4). The Columbia River study was related to community Flood Insurance Studies (References 14 and 15). The Lewis River study was carried out for purposes of a Flood Plain Information report (Reference 16). Columbia River cross sections were based on a U.S. Army Corps of Engineers condition survey, dated August 1974, and topographic maps, dated 1963 (Reference 17). Lewis River cross sections were based on U.S. Army Corps of Engineers mapping performed in 1973 (Reference 18).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-year	100-Year	500-Year
Columbia River					
Downstream of Cowlitz River	256,000	--[1]	--[1]	--[1]	--[1]
Mill Creek					
Upstream of Study Limit	12.7	1,680	2,260	2,540	3,140
At Mouth	28.6	3,170	4,520	5,190	6,620
Abernathy Creek					
Upstream of Study Limit	12.8	1,740	2,370	2,760	3,420
At Mouth	29.1	3,350	4,900	5,650	7,020
Germany Creek					
Upstream of Study Limit	17.9	2,480	3,280	3,800	4,640
At Mouth	23.5	2,920	3,920	4,550	5,620
Coal Creek					
Upstream of Study Limit	8.2	1,160	1,530	1,730	2,120
At Mouth	26.1	3,250	4,430	5,220	6,460
Harmony Creek					
At Mouth	6.2	860	1,190	1,390	1,750
Coweman River					
At Mouth	127	8,000	10,500	11,600	14,400
Upstream of Goble Creek	82.5	5,800	7,700	9,200	11,100
Goble Creek					
At Mouth	26.5	2,590	3,610	4,090	5,040
North Fork Goble Creek					
At Mouth	11.5	1,170	1,660	1,850	2,250

[1]Discharge-Frequency Relationship Not Determined

Table 3. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Ostrander Creek					
At Mouth	26.4	1,790	3,030	3,580	4,660
South Fork Ostrander Creek					
At Mouth	9.3	570	1,080	1,300	1,790
Arkansas Creek					
Upstream of Delameter Creek	20.3	1,860	2,760	3,110	4,220
At Mouth	45.5	4,320	6,260	7,200	9,530
Delameter Creek					
At Confluence With Arkansas Creek	23.4	2,380	3,370	4,010	5,060
Monahan Creek					
At Mouth	10.6	1,150	1,640	2,000	2,430
Kalama River					
Upstream of Study Limit	129.2	13,900	18,300	21,600	26,800
At Mouth	205.0	16,500	22,450	25,000	31,500
Lewis River					
At Mouth	1,04[illegible]	75,000[1]	114,100[1]	132,700[1]	181,000[1]
At Woodland	82[illegible]	54,400[1]	86,300[1]	102,000[1]	142,000[1]
At U.S. Geological Survey Gage Near Ariel	73[illegible]	49,000[1]	79,000[1]	94,000[1]	132,000[1]

[1] Regulated by Merwin Dam

Channel and overbank roughness factors (Manning's "n") were based on field inspection and photographs at each cross section location. Channel roughness coefficients ranged from 0.025 to 0.060; overbank coefficients ranged from 0.070 to 0.150.

For Lewis River, starting water-surface elevations were obtained from a U.S. Army Corps of Engineers Flood Plain Information report (Reference 16). For all other streams in the study, starting water-surface elevations were derived using the slope-area method.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

The hydraulic analyses for this study are based on unobstructed flow. The flood elevations are considered valid only if control structures such as culverts and bridges remain generally unobstructed.

For the remaining streams studied by approximate methods, flooding limits for Cowlitz River, Toutle River, North Fork Toutle River, South Fork Toutle River, McCorkle Creek, and North Fork McCorkle Creek were established using field investigation, engineering judgment, and topographic maps (Reference 19).

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

An approximate analysis was performed on a flood area north of River Mile 13 on Lewis River; Backwater from Lewis River is supplemented by flooding from Houghton Creek east of Niemi Road between State Highway 503 and Old Lewis River Road. Using road elevations and eyewitness accounts of the 1977 flood, a water-surface elevation of 53 feet was estimated for the 100-year flood in this area.

Most of the streams selected for approximate analysis were investigated using discharges for detailed analysis, but for the 100-year recurrence interval only. Flood depths were estimated in the field by use of a hand-held programmable calculator using the normal-depth method.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at scales of 1:4,800, with a contour interval of 4 feet (Reference 19); 1:4,800, with a limited contour interval (Reference 20); approximately 1:5,000, with a contour interval of 5 feet (Reference 21); 1:12,000, with a contour interval of 20 feet (Reference 22); and aerial photogrammetric maps at scales of 1:4,800 (Reference 18), and 1:12,000 (Reference 23).

For the streams studied by approximate methods, the boundaries for the 100-year flood were developed using topographic maps at scales of 1:4,800, with a contour interval of 4 feet (Reference 19); 1:24,000, with a contour interval of 10 feet (Reference 24); 1:24,000, with a contour interval of 20 feet (Reference 25); 1:62,500, with a contour interval of 40 feet (Reference 26); 1:62,500, with a contour interval of 50 feet (Reference 27); 1:62,500, with a contour interval of 80 feet (Reference 28); and aerial photogrammetric maps at scales of 1:4,800 (Reference 18) and 1:6,000 (Reference 29), in conjunction with the previously estimated elevations.

Approximate flood boundaries in some portions of the study area were taken from the Federal Insurance Administration Flood Hazard Boundary Map (Reference 30).

The 100- and 500-year flood boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown.

Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a

floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodways developed in this study were computed on the basis of equal-conveyance reduction from each side of the flood plain. The floodway along Columbia River was adjusted by agreement among the Federal Insurance Administration, Cowlitz County, and the study contractor because of U.S. Army Corps of Engineers dredging operations. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood boundaries are close together, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 6.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Columbia River								
A	56.00	4630/720	230,440	3.7	12.9	12.9	13.5	0.6
B	56.76	5530/570	213,305	4.0	13.1	13.1	13.7	0.6
C	57.38	5840/1000	215,754	4.0	13.3	13.3	13.9	0.6
D	58.00	3770/1500	145,605	5.9	13.4	13.4	14.0	0.6
E	58.38	3750/2050	134,344	6.4	13.5	13.5	14.1	0.6
F	58.85	4062/2260[3]	130,453	6.6	13.8	13.8	14.4	0.6
G	59.57	5864/4650[3]	147,242	5.8	14.2	14.2	14.7	0.5
H	60.36	4748/2500	180,826	4.8	14.4	14.4	15.0	0.6
I	62.40	4456/1300	184,392	4.7	15.2	15.2	15.7	0.5
J	64.25	3548/1800	182,840	4.7	15.9	15.9	16.3	0.4
K	66.10	3008/1360	160,446	5.4	16.3	16.3	16.7	0.4
L	67.19	2982/1250	153,145	5.7	16.6	16.6	17.0	0.4
M	68.80	4500/2950[3]	194,686	4.8	17.4	17.4	17.8	0.4
N	70.17	4415/2800[3]	199,856	5.1	17.7	17.7	18.1	0.4

[1]Miles Above Mouth [2]Width/Width Within County Limits [3]Width Does Not Include Island

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

COLUMBIA RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Columbia River (Cont'd)								
O	71.93	2750/ 1750	155,799	5.3	18.3	18.3	18.7	0.4
P	73.57	3330/ 1250	134,850	6.1	18.8	18.8	19.2	0.4
Q	74.19	3720/600	157,217	5.2	19.2	19.2	19.6	0.4
R	75.57	4198/460	173,273	4.7	19.6	19.6	20.0	0.4
S	76.28	4480/720	179,684	4.5	19.7	19.7	20.1	0.4
T	76.95	2835/980	144,245	5.7	19.7	19.7	20.1	0.4
U	77.76	2500/860	122,449	6.7	20.0	20.0	20.4	0.4

[1]Miles Above Mouth [2]Width/Width Within County Limits

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

COLUMBIA RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Mill Creek								
A	0.007	69	944	5.5	12.3	12.3	13.3	1.0
B	0.062	113	1549	3.4	12.9	12.9	13.8	0.9
C	0.278	107	615	8.4	13.6	13.6	14.6	1.0
D	0.310	83	709	7.3	15.8	15.8	15.8	0.0
E	0.541	60	435	11.9	27.8	27.8	28.6	0.8
F	0.792	33	343	15.0	52.2	52.2	52.5	0.3
G	1.027	96	572	8.8	85.1	85.1	86.0	0.9
H	1.124	31	282	10.3	90.1	90.1	90.6	0.5
I	1.144	70	516	5.6	92.9	92.9	92.9	0.0
J	1.491	45	225	12.7	127.2	127.2	127.2	0.0
K	1.616	49	216	13.2	141.3	141.3	141.4	0.1
L	1.634	131	590	4.8	144.8	144.8	144.8	0.0
M	1.828	109	337	8.3	160.3	160.3	160.3	0.0
N	1.897	58	276	10.2	166.6	166.6	166.6	0.0
O	1.928	146	413	6.8	169.0	169.0	169.0	0.0
P	2.027	35	226	12.4	180.0	180.0	180.0	0.0
Q	2.063	154	650	4.2	183.1	183.1	183.3	0.2
R	2.246	57	236	11.7	205.7	205.7	205.7	0.0
S	2.744	425	1285	2.1	244.2	244.2	244.9	0.7
T	2.776	168	361	7.3	244.9	244.9	245.2	0.3
U	2.791	94	468	5.7	246.3	246.3	246.3	0.0
V	3.123	230	734	3.6	262.6	262.6	263.5	0.9
W	3.475	58	377	6.9	286.0	286.0	286.5	0.5

[1]Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

MILL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Abernathy Creek								
A	0.000	247	1837	3.1	7.8	7.8	8.8	1.0
B	0.023	163	849	6.7	7.8	7.8	8.8	1.0
C	0.083	137	1117	5.1	8.8	8.8	9.5	0.7
D	0.308	151	693	8.2	12.3	12.3	12.3	0.0
E	0.517	190	1220	4.6	19.6	19.6	20.5	0.9
F	0.874	86	583	7.2	35.4	35.4	35.8	0.4
G	1.349	58	521	7.8	65.1	65.1	65.9	0.8
H	1.409	70	447	9.0	68.2	68.2	68.5	0.3
I	1.428	61	500	8.1	69.8	69.8	69.8	0.0
J	1.572	58	330	10.7	77.1	77.1	77.8	0.7
K	1.640	104	449	7.8	84.3	84.3	84.3	0.0
L	1.662	78	573	6.1	85.5	85.5	85.5	0.0
M	1.961	166	723	4.8	104.1	104.1	104.9	0.8
N	2.040	146	590	5.9	111.4	111.4	112.0	0.6
O	2.075	187	1219	2.8	115.2	115.2	115.6	0.4
P	2.423	72	427	8.0	133.8	133.8	134.7	0.9
Q	2.552	69	418	8.2	141.3	141.3	141.9	0.6
R	2.599	44	311	11.0	145.4	145.4	145.4	0.0
S	2.617	142	748	4.6	148.5	148.5	148.5	0.0
T	2.973	70	398	8.5	174.5	174.5	174.6	0.1
U	3.044	37	304	11.1	180.5	180.5	180.7	0.2
V	3.104	74	380	8.9	186.5	186.5	186.5	0.0
W	3.500	70	281	11.8	217.3	217.3	217.3	0.0
X	3.575	37	326	9.0	227.7	227.7	228.1	0.4
Y	3.625	65	471	6.2	230.8	230.8	231.2	0.4
Z	3.854	89	327	8.8	249.6	249.6	249.9	0.3
AA	4.173	75	399	7.2	275.5	275.5	276.4	0.9

[1]Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

ABERNATHY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Abernathy Creek (Cont'd)								
AB	4.483	147	673	4.3	293.2	293.2	294.2	1.0
AC	4.651	95	458	6.3	302.8	302.8	303.1	0.3
AD	4.737	46	227	12.7	311.1	311.1	311.1	0.0
AE	4.838	45	394	7.2	318.8	318.8	319.5	0.7
AF	4.981	83	335	8.5	328.0	328.0	328.8	0.8
AG	5.222	74	357	7.9	351.1	351.1	351.1	0.0
AH	5.489	74	355	7.9	370.4	370.4	371.2	0.8
AI	5.864	59	347	7.9	399.9	399.9	400.6	0.7

[1]Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

ABERNATHY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Germany Creek								
A	0.000	141	823	5.5	13.0	4.8[2]	5.8[2]	1.0
B	0.033	130	350	13.0	13.0	6.7[2]	6.7[2]	0.0
C	0.069	114	775	5.9	13.0	10.6[2]	10.6[2]	0.0
D	0.445	75	556	8.2	18.6	18.6	19.4	0.8
E	0.827	185	597	7.6	29.6	29.6	30.4	0.8
F	1.191	108	761	6.0	48.9	48.9	49.8	0.9
G	1.555	78	458	9.7	65.5	65.5	66.4	0.9
H	1.880	94	669	6.5	80.4	80.4	80.4	0.0
I	2.174	152	637	6.7	89.3	89.3	89.9	0.6
J	2.591	95	546	7.8	109.8	109.8	109.8	0.0
K	3.030	72	341	12.3	136.3	136.3	137.0	0.7
L	3.352	106	586	7.0	157.0	157.0	158.0	1.0
M	3.791	91	379	10.5	181.0	181.0	181.0	0.0
N	4.214	44	397	10.1	209.7	209.7	210.0	0.3
O	4.582	83	456	8.6	232.4	232.4	233.3	0.9
P	4.982	79	350	11.0	256.2	256.2	256.2	0.0
Q	5.383	65	412	9.2	289.2	289.2	289.5	0.3
R	5.520	61	497	7.6	295.1	295.1	295.9	0.8

[1]Miles Above Mouth [2]Elevation Computed Without Consideration of Backwater Effect From Columbia River

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

GERMANY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Coal Creek								
A	0.466	243	1603	3.3	14.3	11.5[2]	12.5[2]	1.0
B	0.781	131	610	8.6	18.4	18.4	19.4	1.0
C	0.852	51	352	11.3	25.4	25.4	25.8	0.4
D	0.887	277	2013	2.0	28.5	28.5	28.8	0.3
E	1.091	75	351	11.5	50.2	50.2	51.1	0.9
F	1.393	81	455	8.9	91.7	91.7	92.5	0.8
G	1.691	54	448	8.7	127.6	127.6	128.6	1.0
H	2.092	42	512	7.6	158.8	158.8	159.3	0.5
I	2.372	74	560	7.0	171.2	171.2	172.0	0.8
J	2.617	42	512	7.3	179.0	179.0	179.6	0.6
K	3.005	243	1420	2.6	196.5	196.5	197.5	1.0
L	3.077	110	589	6.4	197.6	197.6	198.4	0.8
M	3.110	63	463	8.1	198.4	198.4	199.0	0.6
N	3.326	48	337	11.1	208.7	208.7	209.6	0.9
O	3.700	55	474	7.6	229.1	229.1	229.3	0.2
P	3.972	72	405	8.9	254.1	254.1	254.5	0.4
Q	4.188	64	505	6.3	263.6	263.6	263.8	0.2
R	4.337	78	290	11.0	274.8	274.8	274.8	0.0
S	4.387	76	337	9.5	280.4	280.4	280.4	0.0
T	4.607	75	598	5.3	290.3	290.3	290.4	0.1
U	5.100	56	383	8.3	314.4	314.4	315.0	0.6
V	5.417	91	433	6.4	331.8	331.8	332.3	0.5
W	5.800	67	278	10.0	372.3	372.3	372.4	0.1
X	6.032	59	226	11.2	404.2	404.2	404.2	0.0

[1]Miles Above Mouth [2]Elevation Computed Without Consideration of Influence from Columbia River

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

COAL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Harmony Creek								
A	0.258	21	127	11.0	97.9	97.9	98.0	0.1
B	0.428	21	120	10.4	178.9	178.9	178.9	0.0
C	0.637	25	132	9.4	237.5	237.5	237.7	0.2
D	0.989	53	286	4.3	278.6	278.6	279.3	0.7
E	1.041	30	136	6.9	290.2	290.2	290.8	0.6
F	1.092	69	512	1.8	295.2	295.2	295.8	0.6
G	1.408	12	74	11.8	313.1	313.1	313.1	0.0
H	1.832	40	91	9.0	336.5	336.5	336.5	0.0
I	2.091	42	161	4.7	360.5	360.5	361.5	1.0

[1]Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

HARMONY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Coweman River								
A	11.066	268	1,644	7.4	140.8	140.8	141.8	1.0
B	11.201	55	681	13.5	156.9	156.9	156.9	0.0
C	11.244	138	1,351	6.8	161.0	161.0	161.0	0.0
D	11.630	169	1,057	8.7	170.7	170.7	170.7	0.0
E	11.938	192	1,598	5.8	177.0	177.0	177.0	0.0
F	12.189	224	1,166	7.9	182.2	182.2	182.2	0.0
G	12.568	314	1,292	7.1	196.7	196.7	196.7	0.0
H	12.842	201	1,370	6.7	204.5	204.5	204.5	0.0
I	13.110	174	1,386	6.6	209.4	209.4	209.4	0.0
J	13.193	130	1,130	8.1	210.9	210.9	210.9	0.0
K	13.231	297	2,052	4.5	212.6	212.6	212.6	0.0
L	13.311	225	1,516	6.0	213.7	213.7	213.7	0.0
M	13.500	331	1,509	6.1	217.2	217.2	217.2	0.0
N	13.765	172	1,030	8.9	222.1	222.1	222.1	0.0
O	14.227	173	1,110	8.2	234.8	234.8	234.8	0.0
P	14.310	72	710	12.9	237.4	237.4	237.4	0.0
Q	14.338	206	1,402	6.5	241.5	241.5	241.5	0.0
R	14.669	190	1,006	9.1	247.4	247.4	247.4	0.0
S	14.962	174	1,222	7.5	256.7	256.7	256.7	0.0
T	15.523	190	1,043	8.8	272.5	272.5	272.5	0.0
U	15.778	212	1,368	6.7	278.7	278.7	278.7	0.0
V	15.873	172	1,094	8.3	280.5	280.5	280.5	0.0
W	15.896	145	1,048	8.7	281.0	281.0	281.0	0.0
X	16.240	150	1,171	7.8	290.2	290.2	290.2	0.0
Y	16.573	219	928	9.8	303.3	303.3	303.3	0.0
Z	16.668	100	869	10.4	308.5	308.5	308.5	0.0
AA	16.687	264	2,247	4.0	312.2	312.2	312.4	0.2

[1] Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

COWEMAN RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Coweman River (Cont'd)								
AB	16.944	166	1,114	8.1	315.4	315.4	315.7	0.3
AC	17.316	138	946	9.5	327.7	327.7	327.7	0.0
AD	17.563	133	930	9.7	334.5	334.5	334.5	0.0
AE	17.805	181	835	10.7	342.5	342.5	342.5	0.0
AF	18.095	325	1,105	8.1	355.6	355.6	355.6	0.0
AG	18.394	133	885	10.1	366.3	366.3	366.3	0.0

[1] Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

COWEMAN RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Goble Creek								
A	0.034	151	369	11.1	143.2	143.2	143.5	0.3
B	0.109	145	574	7.1	150.2	150.2	150.2	0.0
C	0.185	140	391	10.5	154.3	154.3	154.3	0.0
D	0.260	130	558	7.3	162.1	162.1	162.1	0.0
E	0.335	132	503	8.1	166.7	166.7	166.8	0.1
F	0.391	50	373	11.0	170.2	170.2	170.3	0.1
G	0.412	142	469	8.5	172.1	172.1	172.2	0.1
H	0.471	60	429	9.3	176.7	176.7	176.8	0.1
I	0.530	135	978	4.1	179.1	179.1	179.8	0.7
J	0.590	62	369	10.8	180.6	180.6	180.9	3
K	0.668	55	509	7.8	185.6	185.6	186.2	0.6
L	0.746	165	910	4.4	189.0	189.0	189.5	0.5
M	0.824	90	344	11.5	192.8	192.8	192.8	0.0
N	0.925	225	725	5.5	203.1	203.1	204.1	1.0
O	1.027	85	354	10.9	210.3	210.3	210.3	0.0
P	1.128	139	398	9.7	217.0	217.0	217.2	0.2
Q	1.248	80	334	11.5	226.0	226.0	226.0	0.0
R	1.367	100	413	9.3	234.4	234.4	235.1	0.7
S	1.487	120	549	6.8	242.1	242.1	243.0	0.9
T	1.600	125	404	9.2	251.1	251.1	251.1	0.0
U	1.700	150	506	7.4	256.8	256.8	257.0	0.2
V	1.728	31	166	11.4	258.6	258.6	258.6	0.0
W	1.757	118	461	4.1	262.4	262.4	262.4	0.0
X	1.800	65	368	5.2	263.3	263.3	263.3	0.0
Y	1.862	54	222	8.6	265.4	265.4	265.4	0.0
Z	1.923	71	246	7.7	271.7	271.7	271.8	0.1
AA	1.992	130	243	7.8	277.7	277.7	277.8	0.1

[1] Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

GOBLE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Goble Creek (Cont'd)								
AB	2.061	80	223	8.5	285.0	285.0	285.0	0.0
AC	2.130	61	265	7.2	291.8	291.8	292.3	0.5
AD	2.207	70	268	7.1	297.0	297.0	297.2	0.2
AE	2.283	64	172	11.0	307.6	307.6	307.6	0.0

[1]Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

GOBLE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
North Fork Goble Creek								
A	0.000	70	265	6.9	258.5	258.5	259.5	1.0
B	0.037	10	101	18.2	265.5	265.5	265.5	0.0
C	0.075	144	779	2.4	274.1	274.1	274.1	0.0
D	0.100	85	414	4.4	274.1	274.1	274.1	0.0
E	0.127	39	156	11.8	276.5	276.5	276.5	0.0
F	0.143	80	390	4.7	279.6	279.6	279.6	0.0
G	0.211	82	334	5.5	281.4	281.4	281.4	0.0
H	0.266	70	243	7.6	283.9	283.9	283.9	0.0
I	0.279	69	180	10.2	287.3	287.3	287.3	0.0
J	0.473	96	260	6.6	303.3	303.3	303.3	0.0
K	0.539	115	192	8.9	311.0	311.0	311.0	0.0
L	0.604	55	228	7.5	318.2	318.2	318.2	0.0
M	0.670	52	220	7.8	321.5	321.5	321.5	0.0
N	0.861	154	243	6.5	333.7	333.7	333.7	0.0
O	0.939	40	155	10.2	343.1	343.1	343.1	0.0
P	1.001	85	174	9.1	348.8	348.8	348.8	0.0
Q	1.062	56	175	9.0	353.8	353.8	353.8	0.0
R	1.123	149	213	6.8	362.8	362.8	362.8	0.0
S	1.218	120	222	6.5	374.7	374.7	374.7	0.0
T	1.314	89	163	8.1	384.5	384.5	384.5	0.0
U	1.409	135	278	4.7	394.1	394.1	394.2	0.1
V	1.496	60	143	8.3	400.5	400.5	400.6	0.1
W	1.583	60	122	9.7	409.7	409.7	409.7	0.0
X	1.627	107	297	4.6	413.3	413.3	413.3	0.0
Y	1.670	90	127	9.4	418.1	418.1	418.1	0.0

[1]Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

NORTH FORK GOBLE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Ostrander Creek								
A	0.312	22	437	8.2	28.4	28.4	29.2	0.8
B	0.323	102	1,281	2.8	30.0	30.0	30.7	0.7
C	0.662	113	1,285	2.8	30.6	30.6	31.2	0.6
D	0.750	48	506	7.1	32.5	32.5	33.1	0.6
E	0.778	220	1,182	3.0	33.8	33.8	34.3	0.5
F	1.008	77	490	7.4	35.9	35.9	36.9	1.0
G	1.074	48	311	7.7	43.2	43.2	43.2	0.0
H	1.328	42	225	10.6	62.5	62.5	62.9	0.4
I	1.604	55	223	10.8	103.1	103.1	103.2	0.1
J	1.871	14	212	11.3	158.1	158.1	158.1	0.0
K	1.956	53	363	6.6	162.9	162.9	163.4	0.5

[1] Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

OSTRANDER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
South Fork Ostrander Creek								
A	0.098	60	291	4.5	40.2	40.2	40.4	0.2
B	0.192	61	154	8.4	42.6	42.6	42.7	0.1
C	0.203	35	125	10.4	45.0	45.0	45.0	0.0
D	0.209	55	213	6.1	46.5	46.5	46.5	0.0
E	0.396	35	219	5.9	56.5	56.5	57.0	0.5
F	0.628	25	126	10.3	69.7	69.7	69.7	0.0
G	0.896	58	161	8.1	93.5	93.5	93.8	0.3

[1]Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SOUTH FORK OSTRANDER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Arkansas Creek								
A	0.601	38	717	10.0	42.7	42.7	43.7	1.0
B	0.615	276	3,050	2.4	44.9	44.9	45.7	0.8
C	1.047	247	1,955	3.6	45.9	45.9	46.7	0.8
D	1.098	101	1,280	5.5	46.2	46.2	47.0	0.8
E	1.134	300	2,789	2.5	46.8	46.8	47.5	0.7
F	1.434	480	2,549	2.7	47.6	47.6	48.3	0.7
G	1.828	245	2,975	2.3	48.6	48.6	49.3	0.7
H	1.902	326	757	4.1	49.1	49.1	49.8	0.7
I	1.928	938	4,958	0.6	49.7	49.7	50.5	0.8
J	2.121	1,593	9,405	0.3	49.7	49.7	50.6	0.9
K	2.387	1,100	4,983	0.6	49.7	49.7	50.6	0.9
L	2.708	1,070	3,493	0.9	49.9	49.9	50.8	0.9
M	3.066	216	1,194	2.6	50.5	50.5	51.5	1.0
N	3.238	106	660	4.7	51.6	51.6	52.6	1.0
O	3.346	75	776	4.0	52.8	52.8	53.8	1.0
P	3.387	90	957	3.2	53.2	53.2	54.1	0.9
Q	3.694	106	883	3.5	54.6	54.6	55.3	0.7
R	3.876	75	1,058	2.9	55.2	55.2	55.9	0.7
S	4.017	92	1,105	2.8	55.5	55.5	56.2	0.7
T	4.087	279	1,747	1.7	55.8	55.8	56.5	0.7
U	4.165	100	934	3.1	55.9	55.9	56.6	0.7
V	4.417	81	774	3.8	56.9	56.9	57.5	0.6
W	4.572	90	932	3.2	57.7	57.7	58.2	0.5

[1]Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

ARKANSAS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Delameter Creek								
A	0.402	142	1,502	2.7	49.1	49.1	49.8	0.7
B	0.495	83	997	4.0	49.3	49.3	50.3	1.0
C	0.515	274	2,197	1.8	49.7	49.7	50.6	0.9
D	0.709	309	2,474	1.6	49.9	49.9	50.8	0.9
E	1.394	80	961	4.2	51.2	51.2	52.2	1.0
F	1.724	60	578	6.8	53.8	53.8	54.8	1.0
G	1.789	25	446	8.8	57.5	57.5	58.5	1.0
H	1.825	329	3,658	1.1	59.2	59.2	60.0	0.8
I	1.972	156	1,384	2.8	59.4	59.4	60.2	0.8
J	2.119	141	1,349	2.9	59.8	59.8	60.6	0.8
K	2.393	62	380	9.7	62.7	62.7	63.5	0.8
L	2.583	449	1,449	2.6	69.2	69.2	69.7	0.5
M	2.894	118	633	5.5	79.0	79.0	79.1	0.1
Monahan Creek								
A	0.238	48	251	8.0	95.1	95.1	95.7	0.6

[1] Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

DELAMETER CREEK-MONAHAN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Kalama River								
A	0.772	770	7,970	3.1	18.7	17.3[2]	17.7[2]	0.4
B	1.241	310	5,150	4.9	18.7	17.8[2]	18.2[2]	0.4
C	1.417	350	4,480	5.6	18.7	18.1[2]	19.1[2]	1.0
D	1.623	550	5,680	4.4	19.1	19.1	19.8	0.7
E	1.908	480	6,150	4.1	20.0	20.0	20.8	0.8
F	2.462	720	5,540	4.5	21.7	21.7	22.5	0.8
G	2.771	320	3,546	7.1	23.4	23.4	24.4	1.0
H	3.287	200	2,760	9.1	28.2	28.2	28.6	0.4
I	3.655	460	4,600	5.4	32.2	32.2	32.3	0.1
J	4.086	160	2,050	12.2	36.1	36.1	36.2	0.1
K	4.648	370	4,320	5.8	43.7	43.7	44.3	0.6
L	4.996	190	2,570	9.5	45.9	45.9	46.2	0.3
M	5.422	220	2,450	10.0	51.8	51.8	51.9	0.1
N	5.880	170	2,480	9.8	58.6	58.6	59.6	1.0
O	6.406	210	3,120	7.8	65.5	65.5	66.3	0.8
P	6.640	90	1,410	17.3	67.5	67.5	68.2	0.7
Q	6.929	190	2,970	8.2	76.0	76.0	77.0	1.0
R	7.480	200	2,960	8.2	85.4	85.4	85.5	0.1
S	7.991	180	2,330	10.4	91.1	91.1	91.2	0.1
T	8.567	170	2,370	10.2	101.8	101.8	101.9	0.1
U	9.014	170	2,290	10.5	110.4	110.4	110.4	0.0
V	9.480	150	1,470	16.4	126.7	126.7	126.9	0.2
W	9.634	170	2,440	9.9	135.9	135.9	136.5	0.6
X	9.872	110	1,560	15.3	143.2	143.2	144.0	0.8
Y	10.326	200	2,020	11.9	170.6	170.6	170.9	0.3
Z	10.500	90	1,170	20.4	183.3	183.3	183.4	0.1

[1]Miles Above Mouth [2]Elevation Computed Without Consideration of Backwater Effect From Columbia River

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

KALAMA RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Kalama River (cont'd)								
AA	10.768	160	1,410	16.9	222.9	222.9	222.9	0.0
AB	10.889	190	2,640	9.1	232.9	232.9	232.9	0.0
AC	11.192	290	3,880	6.2	236.8	236.8	237.1	0.3
AD	11.492	250	3,480	6.9	239.2	239.2	239.6	0.4
AE	11.874	280	4,070	5.8	242.7	242.7	243.2	0.5
AF	12.263	250	3,260	7.2	246.5	246.5	247.0	0.5
AG	12.642	160	2,590	9.1	251.9	251.9	252.4	0.5
AH	12.866	180	2,830	8.3	256.2	256.2	256.4	0.2
AI	13.308	150	2,640	8.9	263.3	263.3	264.3	1.0
AJ	13.728	140	2,290	10.3	272.1	272.1	272.2	0.1
AK	14.024	220	3,610	6.4	277.3	277.3	277.4	0.1
AL	14.404	150	3,000	7.6	280.4	280.4	280.5	0.1
AM	14.768	250	3,960	5.8	283.4	283.4	283.6	0.2
AN	15.228	170	2,250	10.1	288.1	288.1	288.2	0.1
AO	15.458	130	1,570	14.5	294.7	294.7	294.7	0.0
AP	15.709	130	2,290	9.9	304.9	304.9	305.5	0.6
AQ	15.937	160	2,590	8.7	309.3	309.3	309.9	0.6
AR	16.073	140	1,280	17.7	313.8	313.8	313.8	0.0
AS	16.217	200	2,540	8.9	323.8	323.8	323.8	0.0
AT	16.432	120	1,290	17.6	332.9	332.9	333.3	0.4
AU	16.708	140	2,250	10.1	347.0	347.0	347.6	0.6
AV	16.859	140	2,280	9.9	350.1	350.1	350.4	0.3
AW	16.923	110	2,210	10.3	351.2	351.2	351.5	0.3
AX	16.951	120	1,790	12.7	351.2	351.2	351.5	0.3

[1]Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

KALAMA RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Kalama River (cont'd)								
AY	17.191	100	1,520	14.8	357.2	357.2	357.2	0.0
AZ	17.520	120	1,560	14.3	368.6	368.6	369.2	0.6
BA	17.907	130	1,920	11.6	380.5	380.5	380.9	0.4
BB	18.085	160	1,610	13.9	385.4	385.4	385.7	0.3
BC	18.385	100	1,260	17.5	396.7	396.7	397.2	0.5
BD	18.605	120	1,740	12.6	404.4	404.4	404.5	0.1
BE	18.898	180	1,890	11.6	409.4	409.4	409.9	0.5
BF	19.186	120	1,530	14.1	415.2	415.2	415.3	0.1
BG	19.496	130	2,000	10.8	420.8	420.8	421.4	0.6
BH	19.785	160	1,670	12.9	425.0	425.0	425.3	0.3

[1]Miles Above Mouth

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

KALAMA RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Lewis River								
A	0.67	969/419[2]	17,362	7.6	23.0	17.1[3]	18.1[3]	1.0
B	1.19	818/418[2]	15,387	8.6	23.0	18.5[3]	19.5[3]	1.0
C	1.70	788/388[2]	17,223	7.7	23.0	20.3[3]	21.0[3]	0.7
D	1.75	799/449[2]	16,955	7.8	23.0	20.7[3]	21.7[3]	1.0
E	2.38	884/464[2]	17,318	7.7	23.0	22.5[3]	23.1[3]	0.6
F	2.98	636/396[2]	14,395	9.2	23.7	23.7	24.5	0.8
G	3.18	536/300[2]	12,769	10.4	24.2	24.2	24.9	0.7
H	3.38	1,090/850[2]	16,615	8.0	25.1	25.1	25.8	0.7
I	3.70	1,130/630[2]	19,165	5.3	26.9	26.9	27.4	0.5
J	3.90	655/335[2]	15,104	6.8	27.1	27.1	27.6	0.5
K	4.29	1,151/301[2]	19,207	5.3	27.7	27.7	28.2	0.5
L	5.01	715/400[2]	17,108	6.0	28.6	28.6	29.2	0.6
M	5.27	547/300[2]	12,906	7.9	28.6	28.6	29.2	0.6
N	5.35	660/350[2]	15,763	6.5	29.2	29.2	29.8	0.6
O	5.42	581/261[2]	14,943	6.8	29.3	29.3	29.9	0.6
P	5.48	511/261[2]	14,815	6.9	29.3	29.3	29.9	0.6
Q	5.95	762[4]	17,384	5.9	30.2	30.2	30.7	0.5
R	6.54	490[4]	13,418	7.6	31.0	31.0	32.0	1.0
S	7.13	1,052[4]	16,808	6.1	32.4	32.4	33.2	0.8
T	7.69	1,462/1,300[2]	21,911	4.7	33.4	33.4	34.2	0.8
U	8.13	716/361[2]	17,283	5.9	34.1	34.1	35.0	0.9
V	8.39	851/361[2]	17,418	5.9	34.5	34.5	35.3	0.8
W	8.61	512/300[2]	12,213	8.4	34.7	34.7	35.5	0.8

[1]Miles Above Mouth [2]Width/Width Within County [3]Elevation Computed Without Consideration of Backwater
[4]Floodway Lies Outside County Limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

LEWIS RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Lewis River (Cont'd)								
X	9.20	1,709/179[2]	27,613	3.7	36.3	36.3	37.1	0.8
Y	9.85	1,420/120[2]	28,526	3.6	37.1	37.1	38.0	0.9
Z	10.69	3,021/185[2]	33,201	3.1	38.0	38.0	38.9	0.9
AA	11.34	2,600/170[2]	30,012	3.4	38.8	38.8	39.7	0.9
AB	11.67	724/104[2]	15,050	6.8	39.3	39.3	40.1	0.8
AC	12.48	420/230[2]	8,954	11.4	42.7	42.7	43.2	0.5
AD	12.95	386/160[2]	9,518	10.7	46.7	46.7	47.0	0.3
AE	13.50	990/170[2]	16,017	6.4	50.2	50.2	51.0	0.8
AF	14.01	658/270[2]	14,327	7.1	52.3	52.3	53.3	1.0
AG	14.44	691/330[2]	19,542	5.2	53.8	53.8	54.8	1.0
AH	15.09	540/390[2]	11,444	8.9	55.0	55.0	56.0	1.0
AI	15.36	373/120[2]	11,212	9.1	56.0	56.0	57.0	1.0
AJ	15.67	499/399[2]	10,651	8.8	57.2	57.2	58.2	1.0
AK	16.08	256/126[2]	7,868	11.9	58.7	58.7	59.6	0.9
AL	16.35	313/43[2]	7,659	12.3	60.5	60.5	61.3	0.8
AM	16.69	438/60[2]	10,160	9.3	62.8	62.8	63.8	1.0
AN	17.08	330/160[2]	8,979	10.5	64.4	64.4	65.4	1.0
AO	17.54	362/160[2]	8,967	10.5	67.0	67.0	67.9	0.9
AP	17.91	257/117[2]	8,179	11.5	68.6	68.6	69.6	1.0
AQ	18.26	339/170[2]	9,552	9.8	70.4	70.4	71.4	1.0
AR	18.65	272/160[2]	8,394	11.2	71.9	71.9	72.9	1.0
AS	19.06	356/220[2]	11,511	8.2	74.6	74.6	75.5	0.9

[1]Miles Above Mouth

[2]Width/Width Within County

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINCORPORATED AREAS)

FLOODWAY DATA

LEWIS RIVER

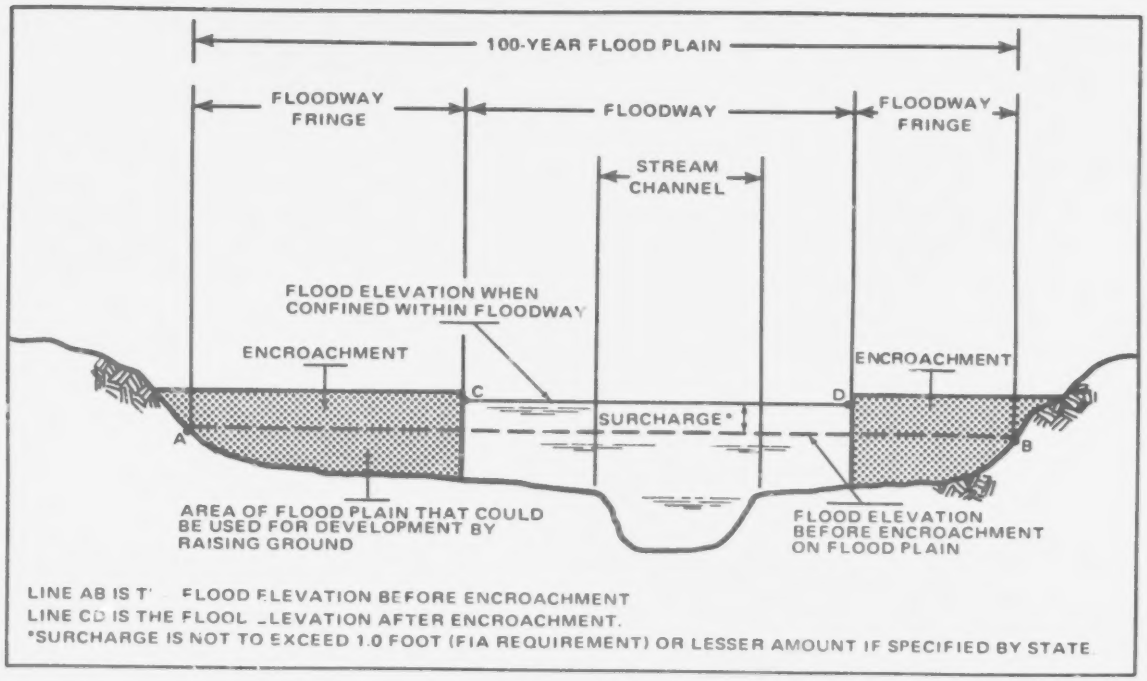
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS T' FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOL _LEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

Figure 6. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting Cowlitz County.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of Cowlitz County are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire unincorporated area of Cowlitz County was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or Flood Hazard Factors determined.
Zones A1-A10 and A15	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Columbia River							
Reach 1	0104,0108						
	0115,0117						
	0120,0140						
	0205	-2.1	-0.6	1.8	020	A4	Varies - See Map
Reach 2	0205,0210						
	0215,0220						
	0285	-3.5	-1.1	2.3	035	A7	Varies - See Map
Mill Creek							
Reach 1	0103,0104						
	0115	-2.0	-0.6	1.2	020	A4	Varies - See Map
Reach 2	0103	-1.0	-0.3	0.6	010	A2	Varies - See Map
Abernathy Creek							
Reach 1	0104	-1.8	-0.6	0.8	020	A4	Varies - See Map
Reach 2	0102,0104	-1.7	-0.5	0.7	015	A3	Varies - See Map
Reach 3	0102	-2.1	-0.7	0.6	020	A4	Varies - See Map
Reach 4	0102	-1.4	-0.5	0.8	015	A3	Varies - See Map
Reach 5	0102	-2.8	-0.9	1.4	030	A6	Varies - See Map
Reach 6	0102	-1.1	-0.4	0.6	010	A2	Varies - See Map
Reach 7	0014,0102	-1.3	-0.4	0.8	015	A3	Varies - See Map
Germany Creek							
Reach 1	0102,0104	-1.3	-0.7	1.0	015	A3	Varies - See Map
Coal Creek							
Reach 1	0109,0117	-1.4	-0.5	0.7	015	A3	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

COLUMBIA RIVER-MILL CREEK-ABERNATHY CREEK-GERMANY CREEK-COAL CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Coal Creek (Cont'd)							
Reach 2	0107,0109	-1.8	-0.7	1.0	020	A4	Varies - See Map
Reach 3	0107	-1.1	-0.4	0.6	010	A2	Varies - See Map
Harmony Creek							
Reach 1	0117	-1.4	-0.5	0.9	015	A3	Varies - See Map
Reach 2	0117	-2.8	-0.9	1.1	030	A6	Varies - See Map
Reach 3	0109,0117	-1.2	-0.5	0.7	010	A2	Varies - See Map
Reach 4	0109,0117	-3.5	-1.1	0.7	035	A7	Varies - See Map
Reach 5	0108,0109	-0.9	-0.3	0.4	010	A2	Varies - See Map
Coweman River							
Reach 1	0144	-1.7	-0.6	0.8	015	A3	Varies - See Map
Reach 2	0144,0145						
	0165	-2.6	-1.1	1.2	025	A5	Varies - See Map
Goble Creek							
Reach 1	0144,0207	-1.6	-0.5	0.8	015	A3	Varies - See Map
North Fork Goble Creek							
Reach 1	0207	-2.2	-0.6	1.3	020	A4	Varies - See Map
Reach 2	0207	-5.0	-1.3	0.8	050	A10	Varies - See Map
Reach 3	0207,0144	-0.9	-0.4	0.6	010	A2	Varies - See Map
Ostrander Creek							
Reach 1	0129	-5.1	-3.5	6.8	050	A10	Varies - See Map
Reach 2	0129	-3.1	-1.0	4.3	030	A6	Varies - See Map
Reach 3	0129	-1.9	-0.9	1.0	020	A4	Varies - See Map
Reach 4	0129	-5.2	-2.1	5.2	050	A10	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

COAL CREEK-HARMONY CREEK-COWEMAN RIVER-GOBLE CREEK-NORTH FORK GOBLE CREEK-OSTRANDER CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
South Fork Ostrander Creek							
Reach 1	0129	-2.1	-0.5	1.1	020	A4	Varies - See Map
Reach 2	0129	-1.3	-0.4	0.7	015	A3	Varies - See Map
Arkansas Creek							
Reach 1	0040	-3.1	-0.9	3.1	030	A6	Varies - See Map
Reach 2	0040	-2.7	-0.7	1.5	025	A5	Varies - See Map
Delameter Creek							
Reach 1	0040	-3.3	-1.1	2.6	035	A7	Varies - See Map
Reach 2	0040	-1.3	-0.5	0.9	015	A3	Varies - See Map
Reach 3	0040	-0.5	-0.1	0.6	005	A1	Varies - See Map
Reach 4	0040	-1.5	-0.6	0.3	015	A3	Varies - See Map
Monahan Creek							
Reach 1	0040	-1.5	-0.6	0.3	015	A3	Varies - See Map
Kalama River							
Reach 1	0220,0240	-3.3	-1.0	2.1	035	A7	Varies - See Map
Lewis River							
Reach 1	0295,0315	-4.6	-1.2	2.3	045	A9	Varies - See Map
Reach 2	0285,0295 0305,0310 0315	-7.3	-2.1	4.8	075	A15	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

SOUTH FORK OSTRANDER CREEK-ARKANSAS CREEK-DELAMETER CREEK-MONAHAN CREEK-KALAMA RIVER-LEWIS RIVER

to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

The flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the county are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Cowlitz County is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

The U.S. Army Corps of Engineers, Portland District, published a Flood Plain Information report of Cowlitz County, Washington, in January 1969 (Reference 1). Rivers studied for this report included Columbia River, Lewis River, Kalama River, Cowlitz River, Toutle River and tributaries, and Coweman River. This Flood Insurance Study supersedes that report.

The U.S. Army Corps of Engineers, Portland District, also prepared, but did not publish, a Flood Plain Information report on Lewis River in May 1976, updated January 1977 (Reference 16). Areas studied for this report extended from River Mile 0.0 to River Mile 14.5. Data presented in this current Flood Insurance Study were obtained from the updated analysis and mapping prepared for that report. This Flood Insurance Study is in general agreement with that report.

This Flood Insurance Study is also in general agreement with the Flood Insurance Studies for the Cities of Kelso, Washington (Reference 15); Longview, Washington (Reference 14); Castle Rock, Washington (Reference 31); and the Town of Kalama, Washington (Reference 32).

Because of the use of more recent data and more detailed study procedures, this Flood Insurance Study supersedes the previously published Federal Insurance Administration Flood Hazard Boundary Map for Cowlitz County, Washington (Reference 30).

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, Federal Regional Center, 130 228th Street, SW., Bothell, Washington 98011.

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23. U.S. Department of the Army, Corps of Engineers, Portland District, Aerial Photogrammetric Maps, Scale 1:12,000, Cowlitz County, Washington, 1976

24. U.S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 feet: St. Helens, Oregon-Washington (1954), Photorevised (1970)

25. U.S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 feet: Deer Island, Oregon (1954), Photorevised (1970); Mt. Brynion, Washington (1953), Photorevised (1970); Kalama, Washington-Oregon (1953), Photorevised (1970); Kelso, Washington-Oregon (1953), Photorevised (1970)

26. U.S. Department of the Interior, Geological Survey, 15-Minute Series Topographic Maps, Scale 1:62,500, Contour Interval 40 feet: Castle Rock, Washington (1953); Yacolt, Washington (1956); La Center, Washington, (1954)

27. U.S. Department of the Interior, Geological Survey, 15-Minute Series Topographic Maps, Scale 1:62,500, Contour Interval 50 feet: Clatskanie, Oregon-Washington (1952)

28. U.S. Department of the Interior, Geological Survey, 15-Minute Series Topographic Maps, Scale 1:62,500, Contour Interval 80 feet: Cougar, Washington (1953); Pigeon Springs, Washington (1953); Toutle, Washington (1953); Elk Rock, Washington (1953)

29. U.S. Department of the Army, Corps of Engineers, Portland District, Aerial Photogrammetric Maps, Scale 1:6000, Cowlitz County, Washington, 1976

30. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Cowlitz County, Washington (Unincorporated Areas), Scale 1:24,000, October 1977

31. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Castle Rock, Cowlitz County, Washington, unpublished

32. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Town of Kalama, Cowlitz County, Washington, unpublished

U.S. Department of Agriculture, Soil Conservation Service, Engineering Division, National Engineering Handbook, Section 4, Hydrology, January 1971

9.0 REVISIONS DESCRIPTION

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of Cowlitz County, Washington at the Department of Community Development, 207 4th Avenue North, Kelso, Washington, 98626.

9.1 First Revision

This study was revised on September 29, 1989, to update the base flood elevations and flood boundary delineations for the Lewis River, and correct a flooding mismatch between Cowlitz County, Washington and the City of Woodland, Washington based on data prepared by the Portland District Office of the U.S. Army Corps of Engineers.

The peak discharges for the 10-, 50-, 100- and 500-year floods were reduced due to the availability of approximately 70,000 acre-feet of storage for flood control. The Lewis River stream gage records were statistically analyzed using the standard log-Pearson Type III distribution, as outlined by the U.S. Water Resources Council (Reference 9). Natural and regulated discharge-frequency curves were developed for the USGS gages at Ariel and Amboy, using data from 1912 to 1978. Peak annual flows used in deriving the natural discharge-frequency curves were calculated by combining observed flows at the gage and by correlating adjacent gaging stations in the Lewis River basin and working downstream to Merwin Dam. The regulated discharge-frequency relationship was developed by comparison of natural versus regulated discharges for six flood events in the basin. The regulated discharges for these floods were based on the Pacific Power & Light plan of flood-control opertion, considering the 70,000 acre-feet of flood control storage at Merwin Dam. This analysis was also used to revise the Flood Insurance Studies for Clark County, Washington (Reference 11), and Woodland, Washington (Reference 12).

The effects of the COE's restudy were first presented to the community in a preliminary Flood Insurance Study report text and corresponding maps dated March 5, 1985. This preliminary study included revisions to several other streams as well as the Lewis River. After review of the preliminary study, all revisions were suspended because the information did not represent conditions that existed after the eruption of Mt. St. Helens. The suspension was pending on the completion of the construction of sediment control structures on the Cowlitz River and the dredging projects throughout the area. However, it was since determined that the

Lewis River data presented in the March 5, 1985 preliminary Flood Insurance Study River does represent existing conditions and will be uneffected by ongoing sediment control projects. The Summary of Discharges Table, Floodway Data Table, Flood Profiles, FIRM and FBFM panels 285, 295, 305, 310, and 315 were revised to reflect the data prepared for the Lewis River as shown on the preliminary FIRM and FBFM dated March 5, 1985.

REACH 1
ZONE AE

Begin of Detailed Study

ELEVATION (FEET NGVD)

60
40
20
0
-20
-40
-60
-80
-100
-120

56.00 56.20 56.40 56.60 56.80 57.00 57.20 57.40 57.60 57.80 58.00 58.20 58.40 58.60

STREAM DISTANCE IN MILES ABOVE MOUTH

A B C D E

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

01P

REACH 1
ZONE AE

ELEVATION (FEET NGVD)

80
60
40
20
0
-20
-40
-60
-80
-100

58.60 58.80 59.00 59.20 59.40 59.60 59.80 60.00 60.20 60.40 60.60 60.80 61.00 61.20

STREAM DISTANCE IN MILES ABOVE MOUTH

F G H

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

FLOOD PROFILES

COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA.
(UNINC. AREAS)

02P

REACH 4
ZONE AE

ELEVATION (FEET NGVD)

60
40
20
0
-20
-40
-60
-80
-100
-120

60.20 60.40 60.60 60.80 61.00 61.20 61.40 61.60 61.80 62.00 62.20 62.40 62.60 62.80

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

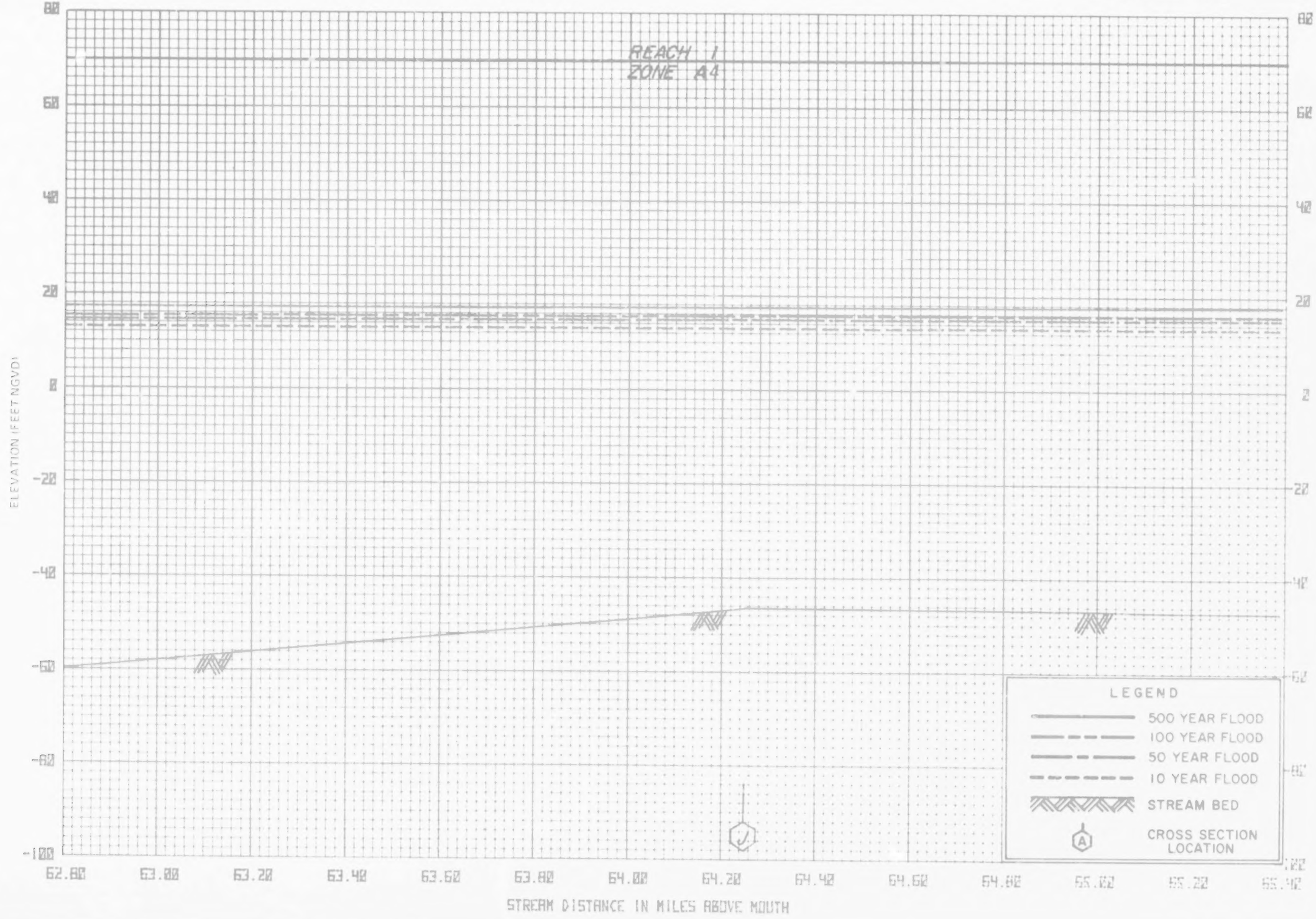
FLOOD PROFILES

COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA.
(UNINC. AREA)

03P



FLOOD PROFILES

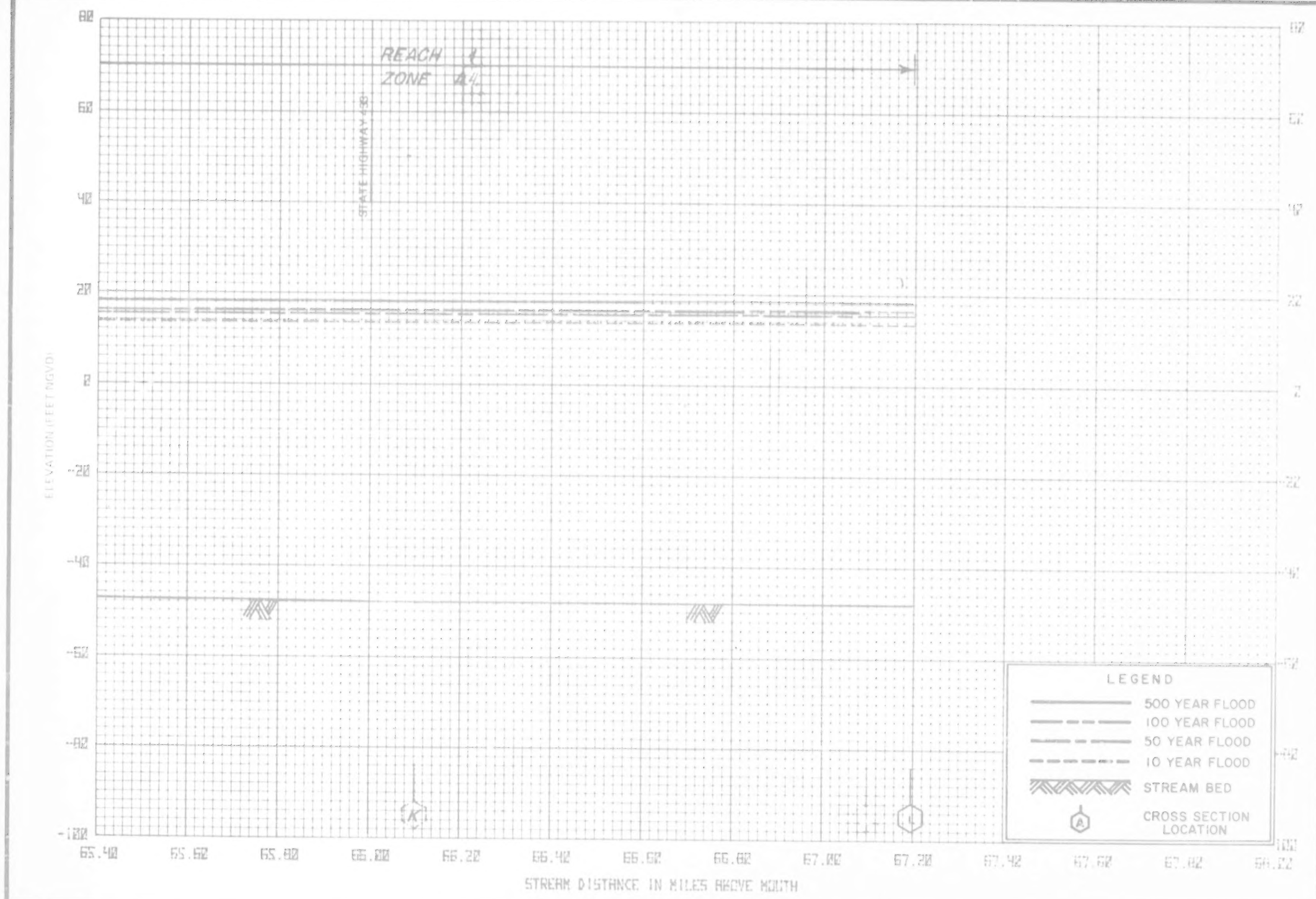
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

UNINCORPORATED AREAS

04P



FLOOD PROFILES

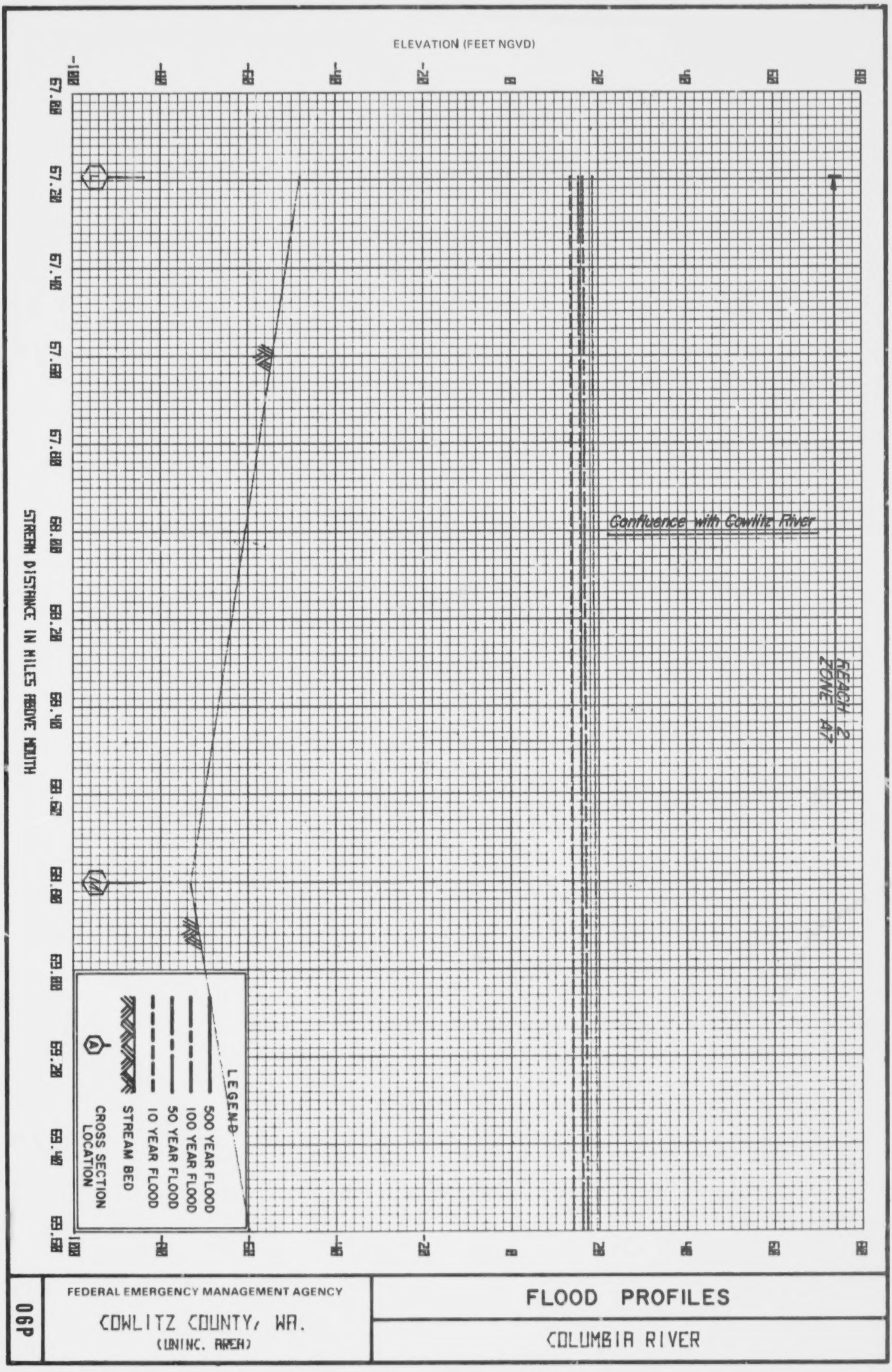
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINCORPORATED AREAS)

05P



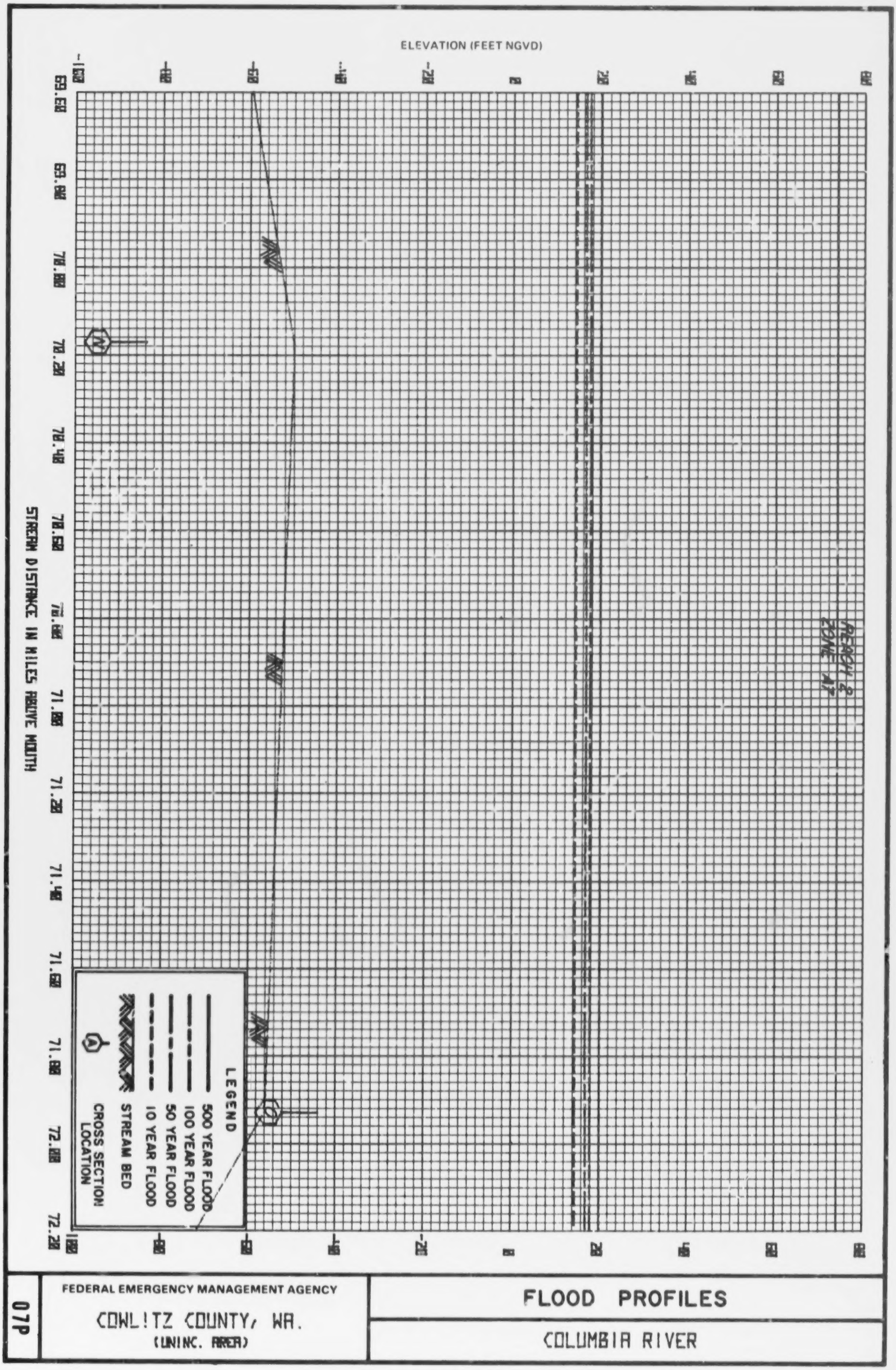
FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA.
(UNINC. AREA)

FLOOD PROFILES

COLUMBIA RIVER

06P



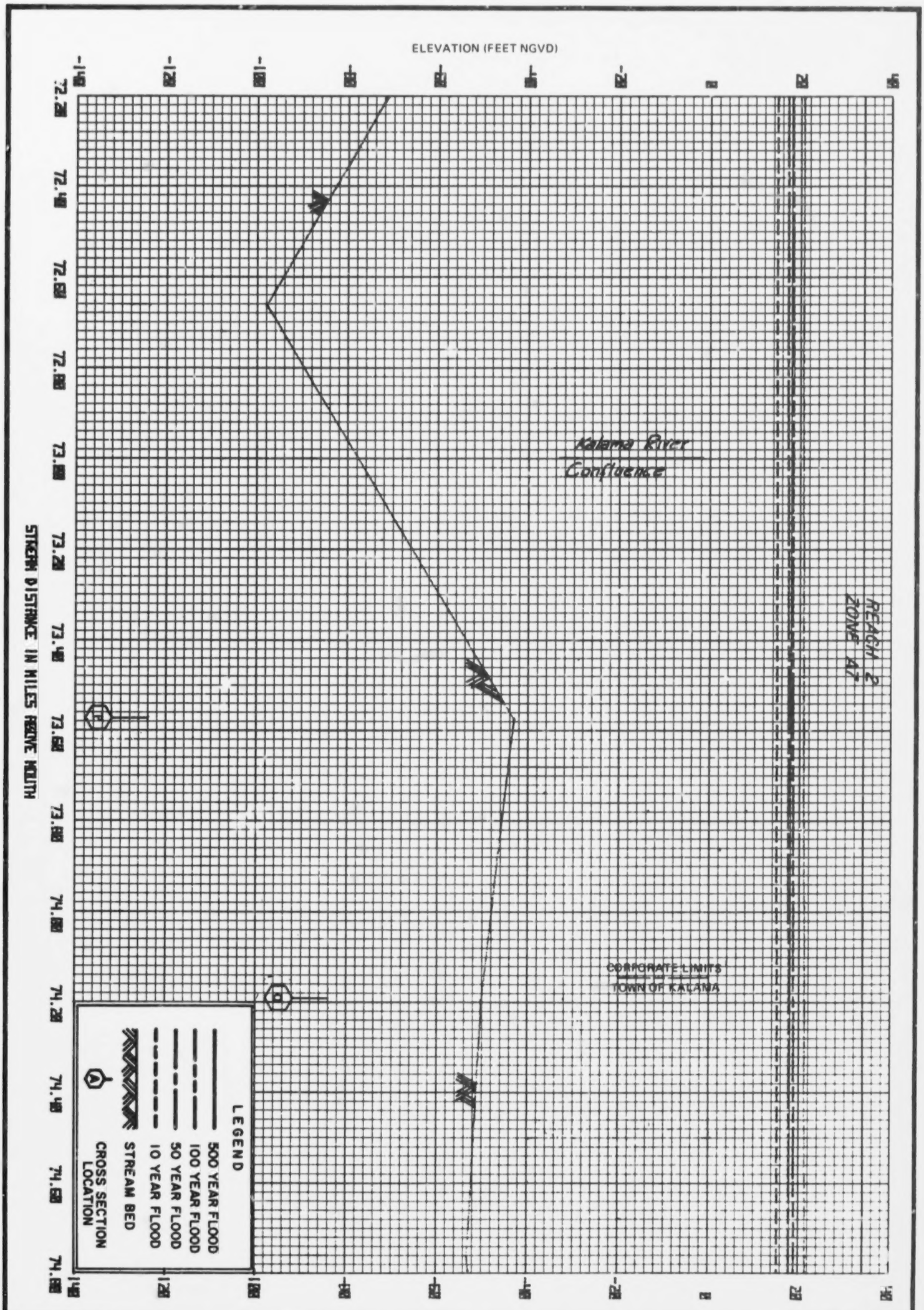
FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA.
(UNINC. AREA)

FLOOD PROFILES

COLUMBIA RIVER

07P



08P	FEDERAL EMERGENCY MANAGEMENT AGENCY COWLITZ COUNTY, WA. (UNINC. AREA)	FLOOD PROFILES COLUMBIA RIVER

REACH 2
ZONE A7

TOWN OF KALAMA
CORPORATE LIMITS

ELEVATION (FEET NGVD)

80
60
40
20
0
-20
-40
-60
-80
-100

74.80 75.00 75.20 75.40 75.60 75.80 76.00 76.20 76.40 76.60 76.80 77.00 77.20 77.40

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION

FLOOD PROFILES

COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA.
(UNINC. AREAS)

09P

REACH 2
ZONE AE

End of detailed study

ELEVATION (FEET NGVD)

80
60
40
20
0
-20
-40
-60
-80
-100

77.40 77.60 77.80 78.00 78.20 78.40 78.60 78.80 79.00 79.20 79.40 79.60 79.80 80.00

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

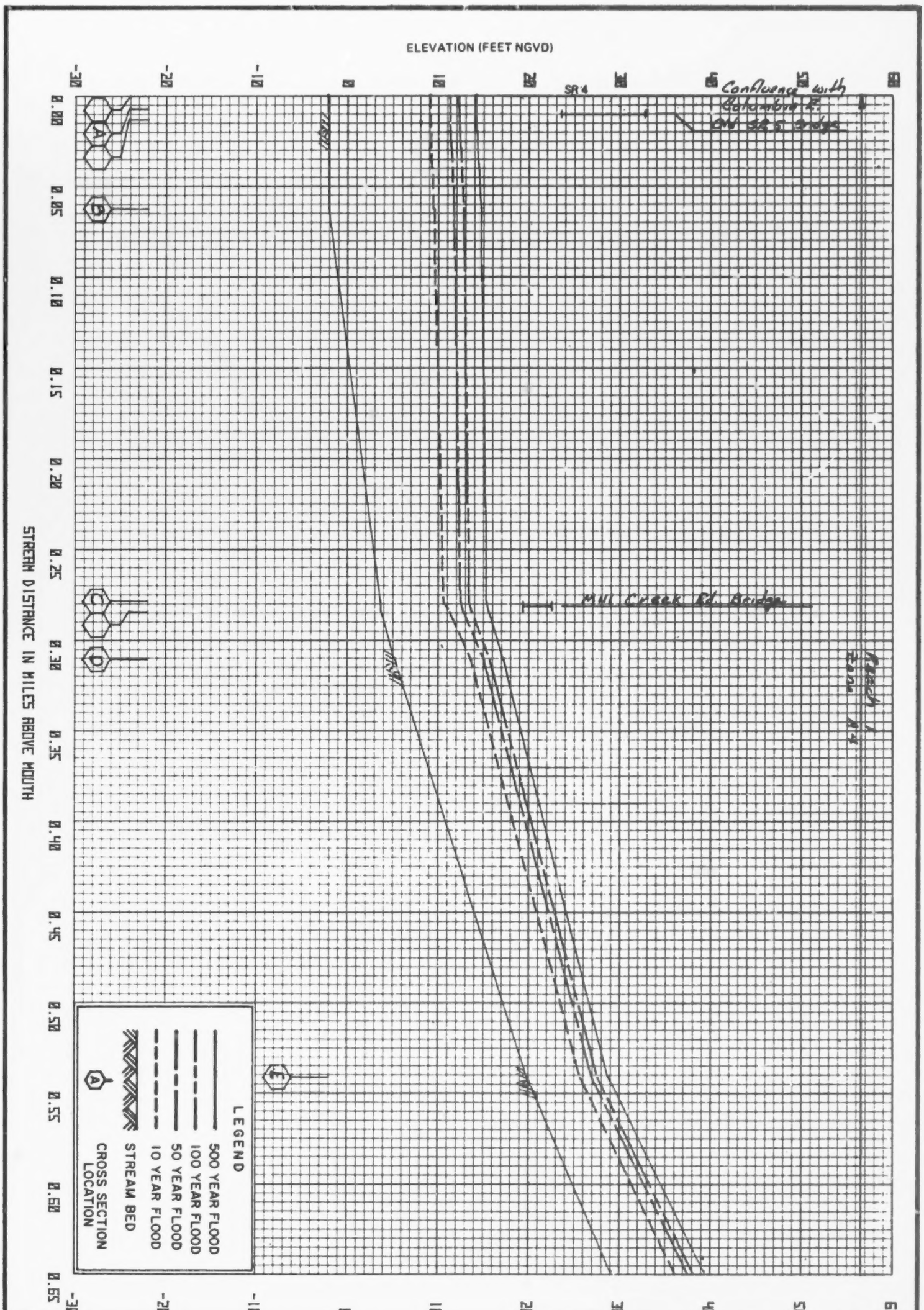
FLOOD PROFILES

COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

10P



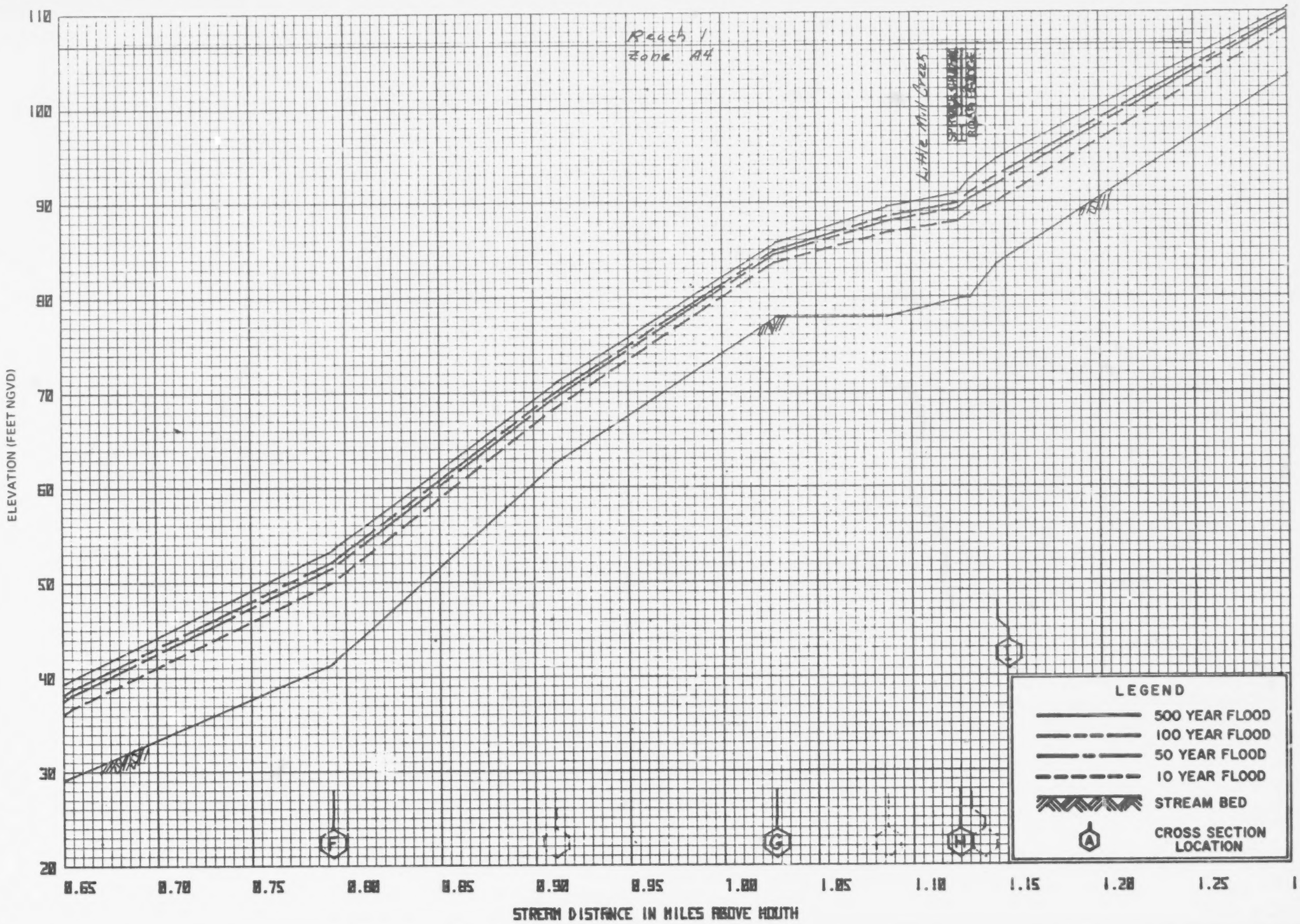
FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

MILL CREEK

11P



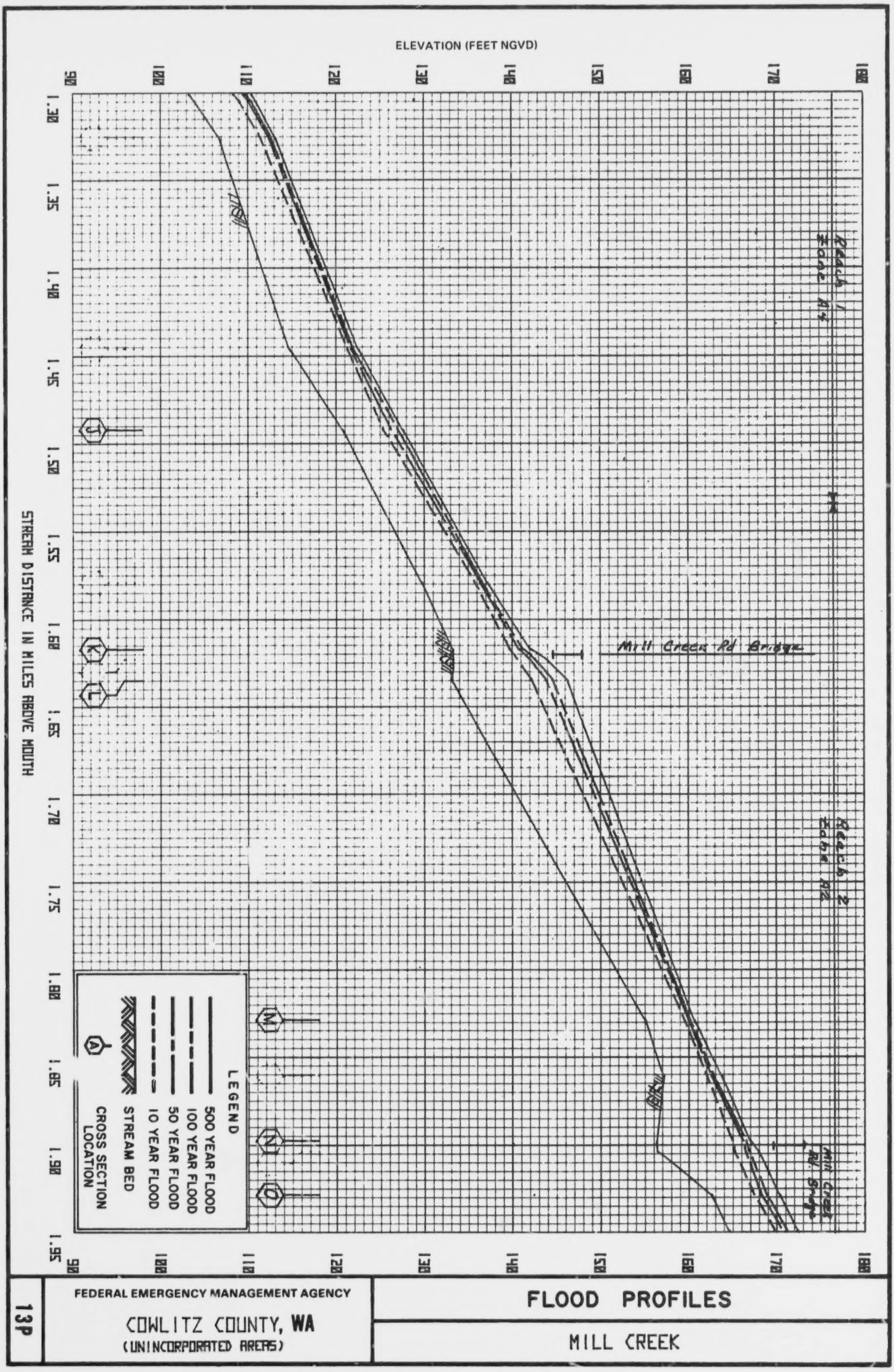
FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

12P



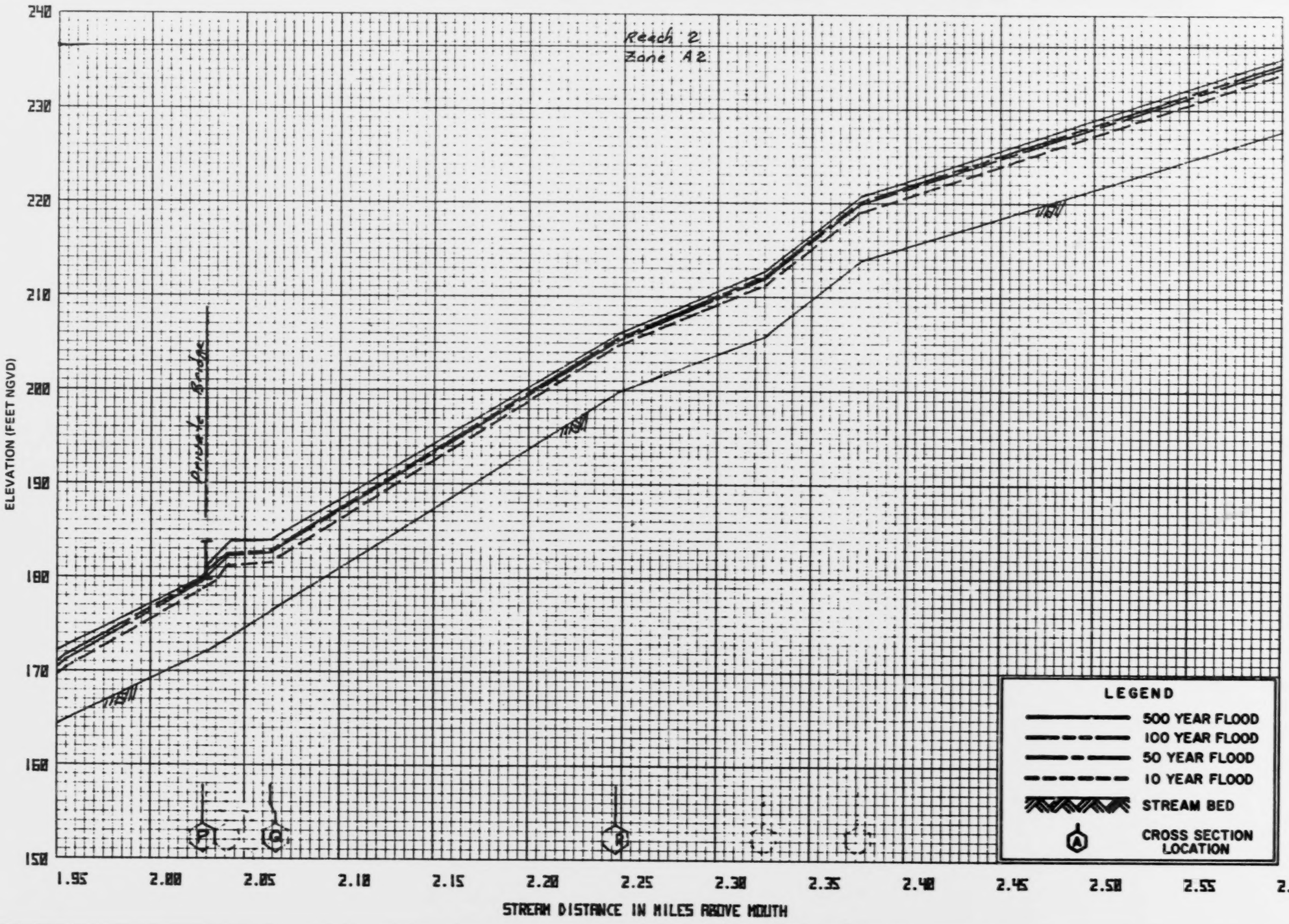
FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

MILL CREEK

13P



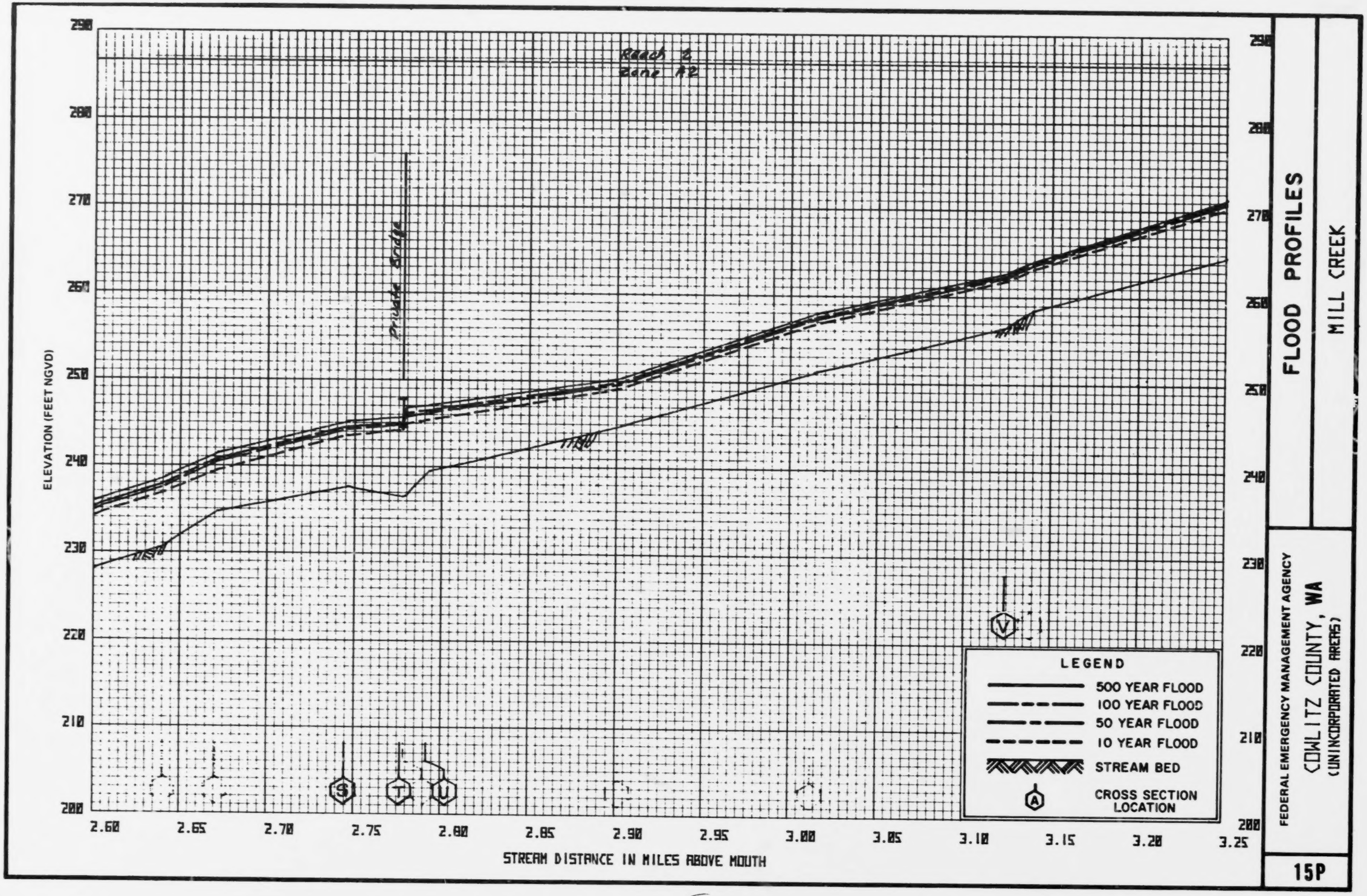
FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

14P



FLOOD PROFILES

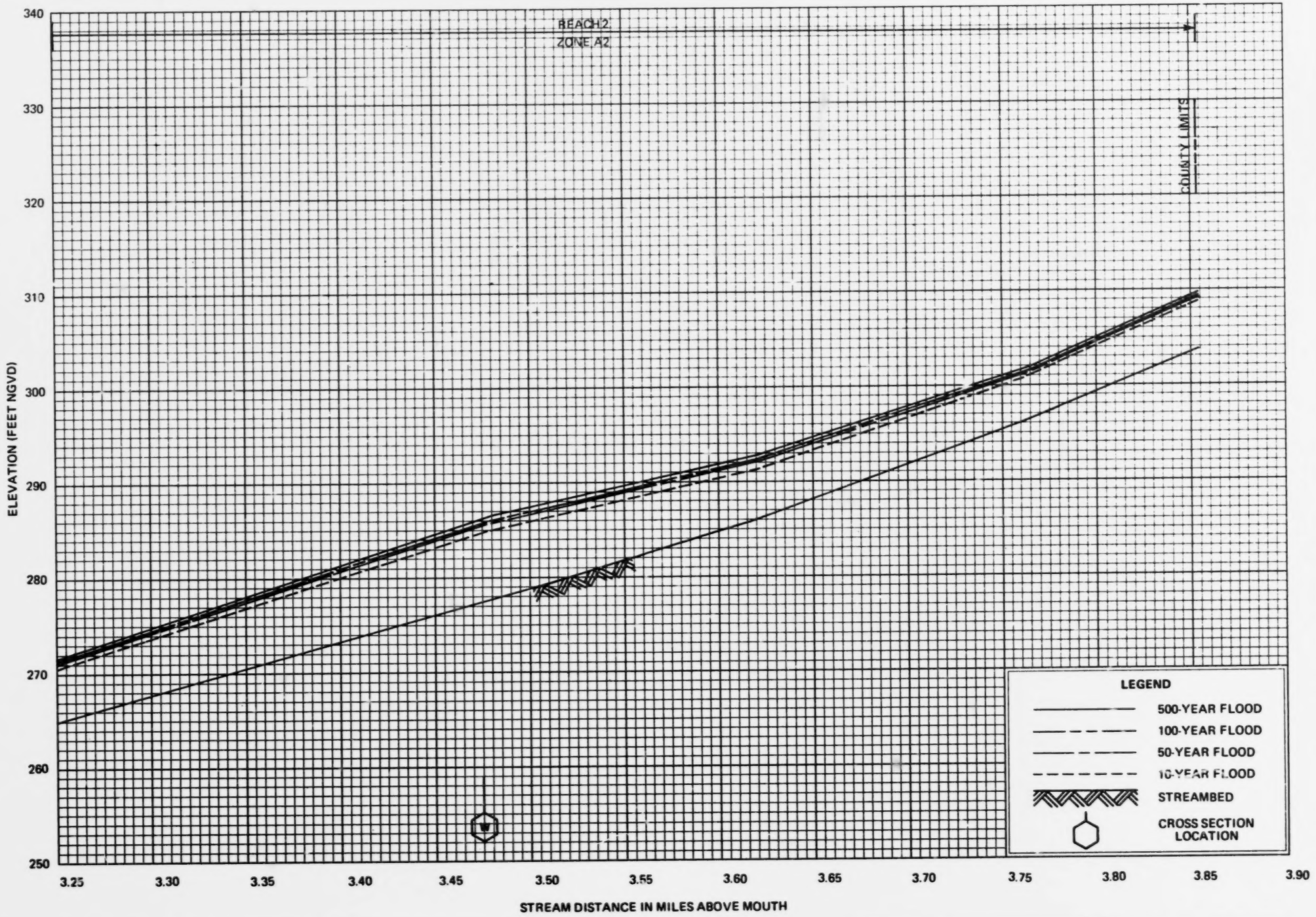
MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINCORPORATED AREAS)

15P



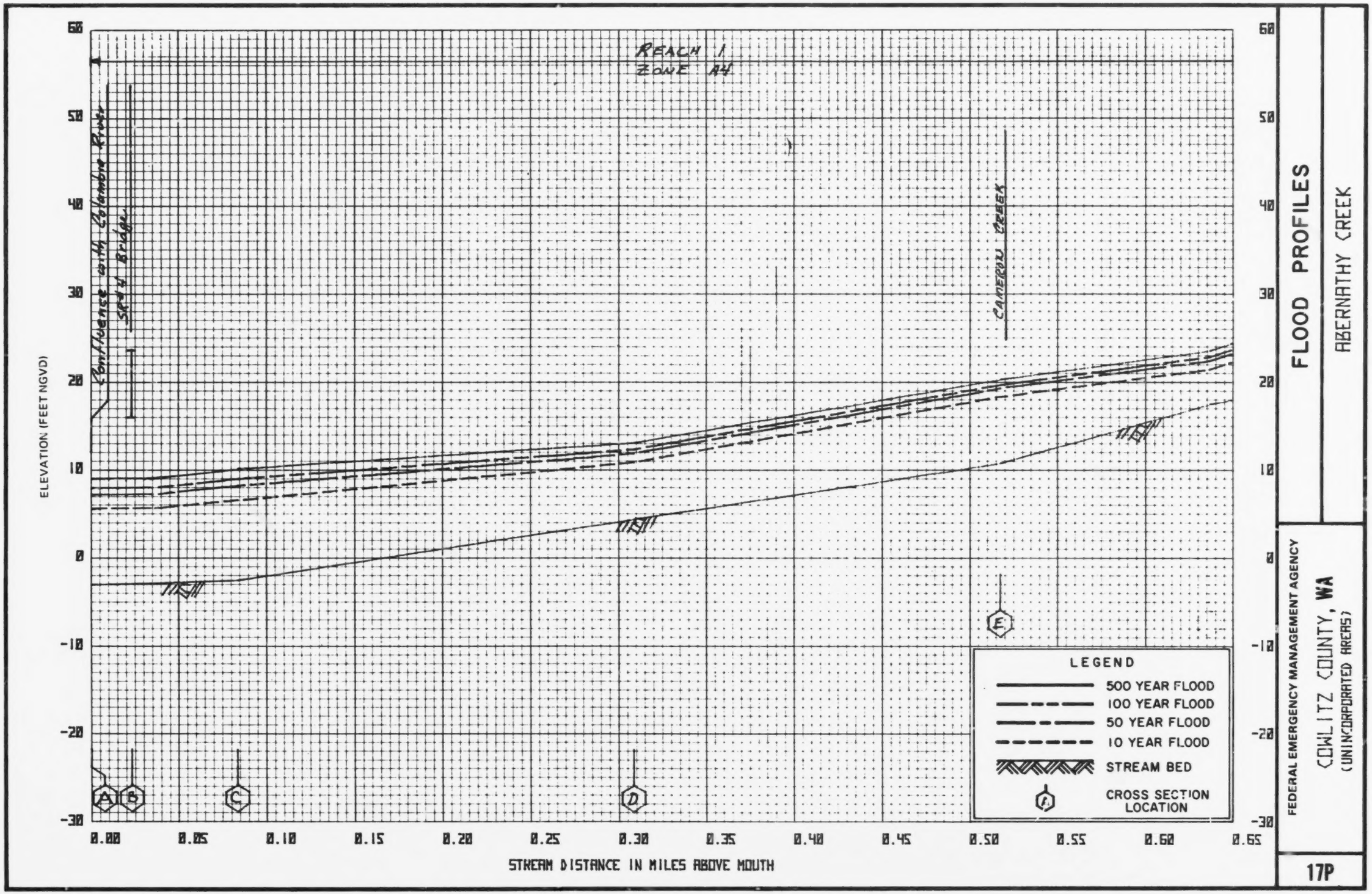
FLOOD PROFILES

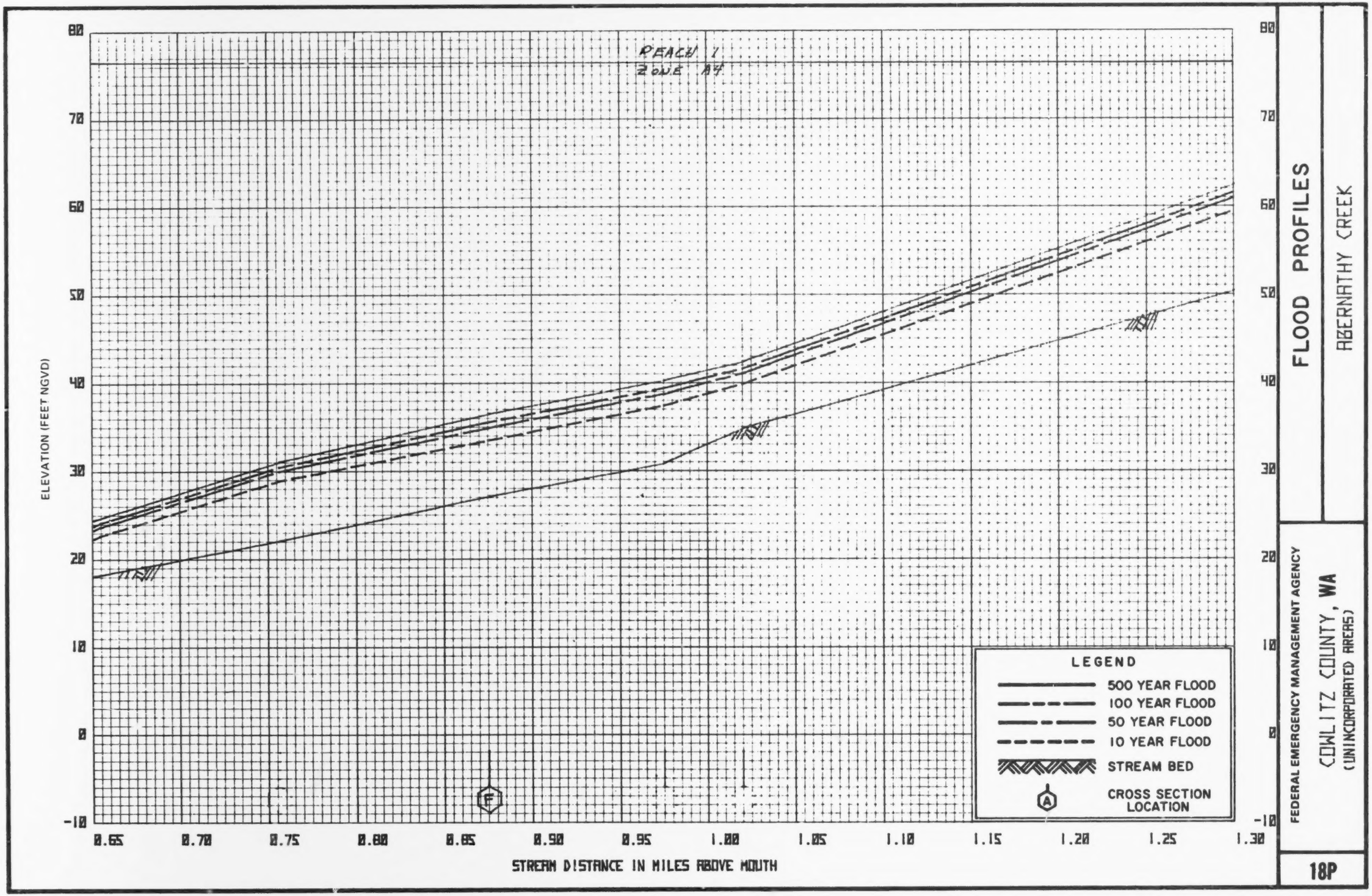
MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

16P


REACH 1
ZONE AH
CANERUU CREEK
Confluence with Columbia River
SR4 #1 Bridge
ELEVATION (FEET NGVD)
60
50
40
30
20
10
0
-10
-20
-30
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
STREAM DISTANCE IN MILES ABOVE MOUTH
A
B
C
D
E
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
FLOOD PROFILES
ABERNATHY CREEK
FEDERAL EMERGENCY MANAGEMENT AGENCY
COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)
17P



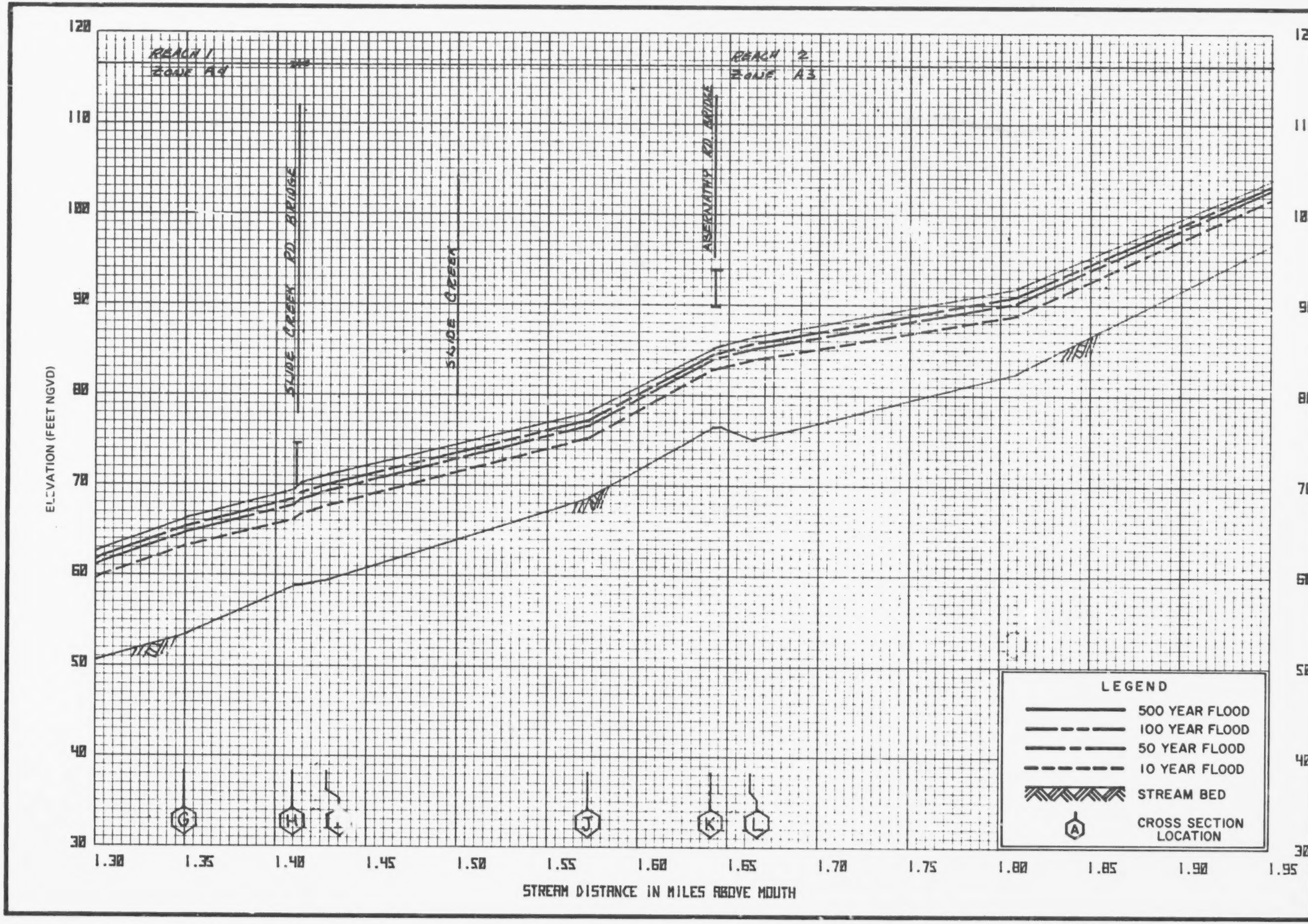
FLOOD PROFILES

ABERNATHY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

18P



FLOOD PROFILES

ABERNATHY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

19P

REACH 2
ZONE A3

PRIVATE LEVEE

ELEVATION (FEET NGVD

170
160
150
140
130
120
110
100
90
80

1.95 2.00 2.05 2.10 2.15 2.20 2.25 2.30 2.35 2.40 2.45 2.50 2.55 2.60

STREAM DISTANCE IN MILES ABOVE MOUTH

M N O P Q R

LEGEND
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

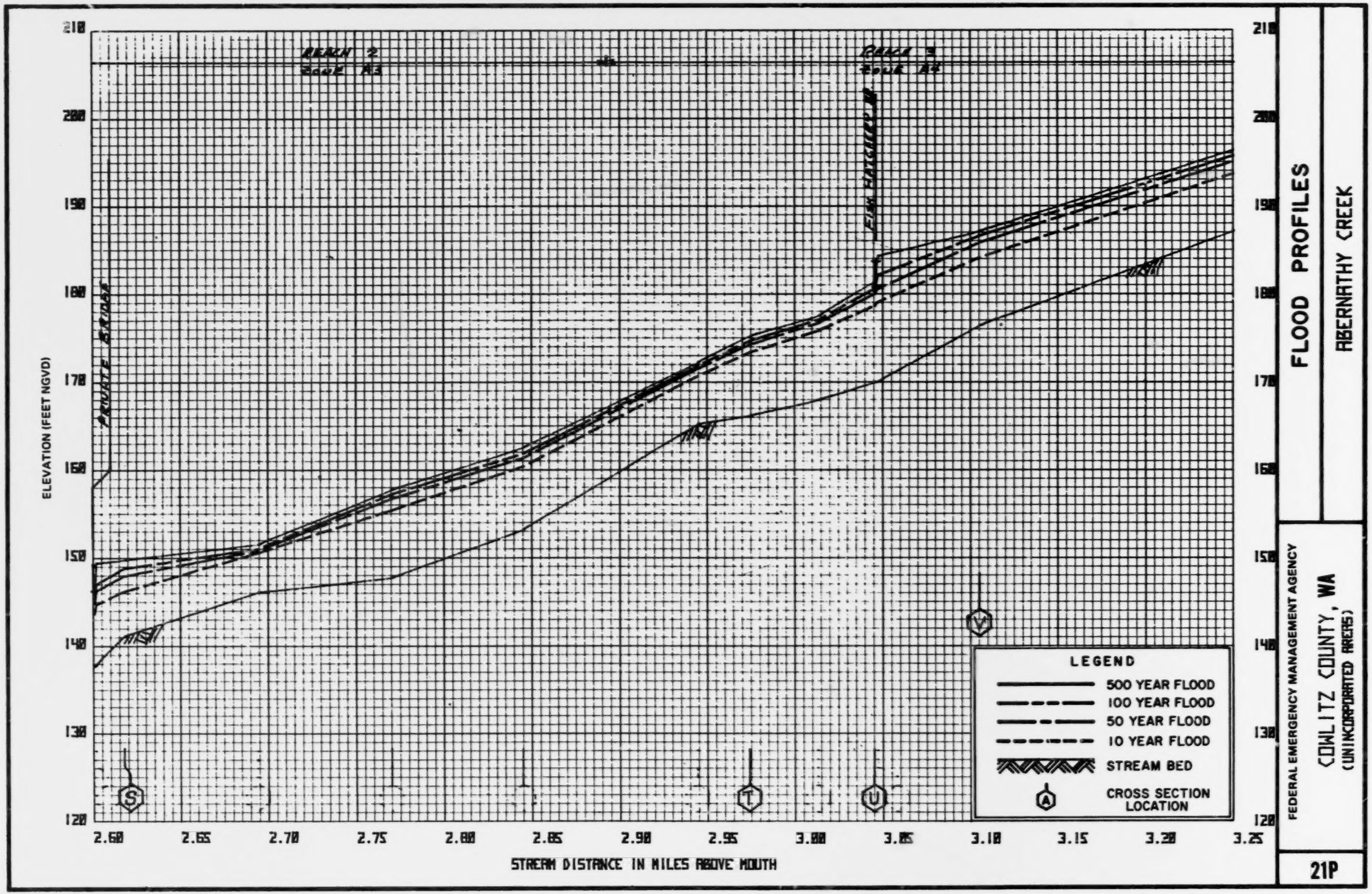
FLOOD PROFILES

ABERNATHY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

20P



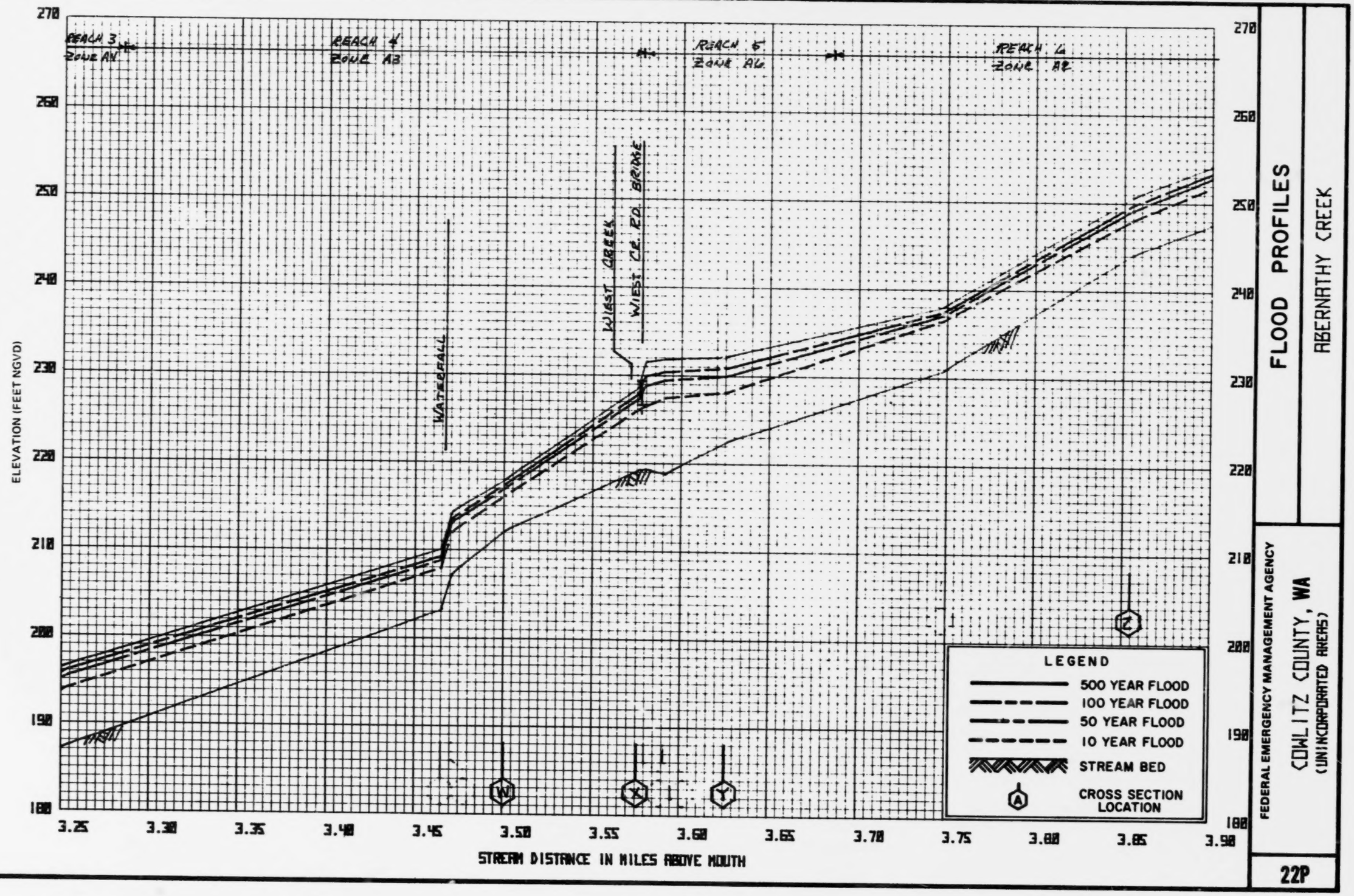
FLOOD PROFILES

ABERNATHY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

21P



FLOOD PROFILES

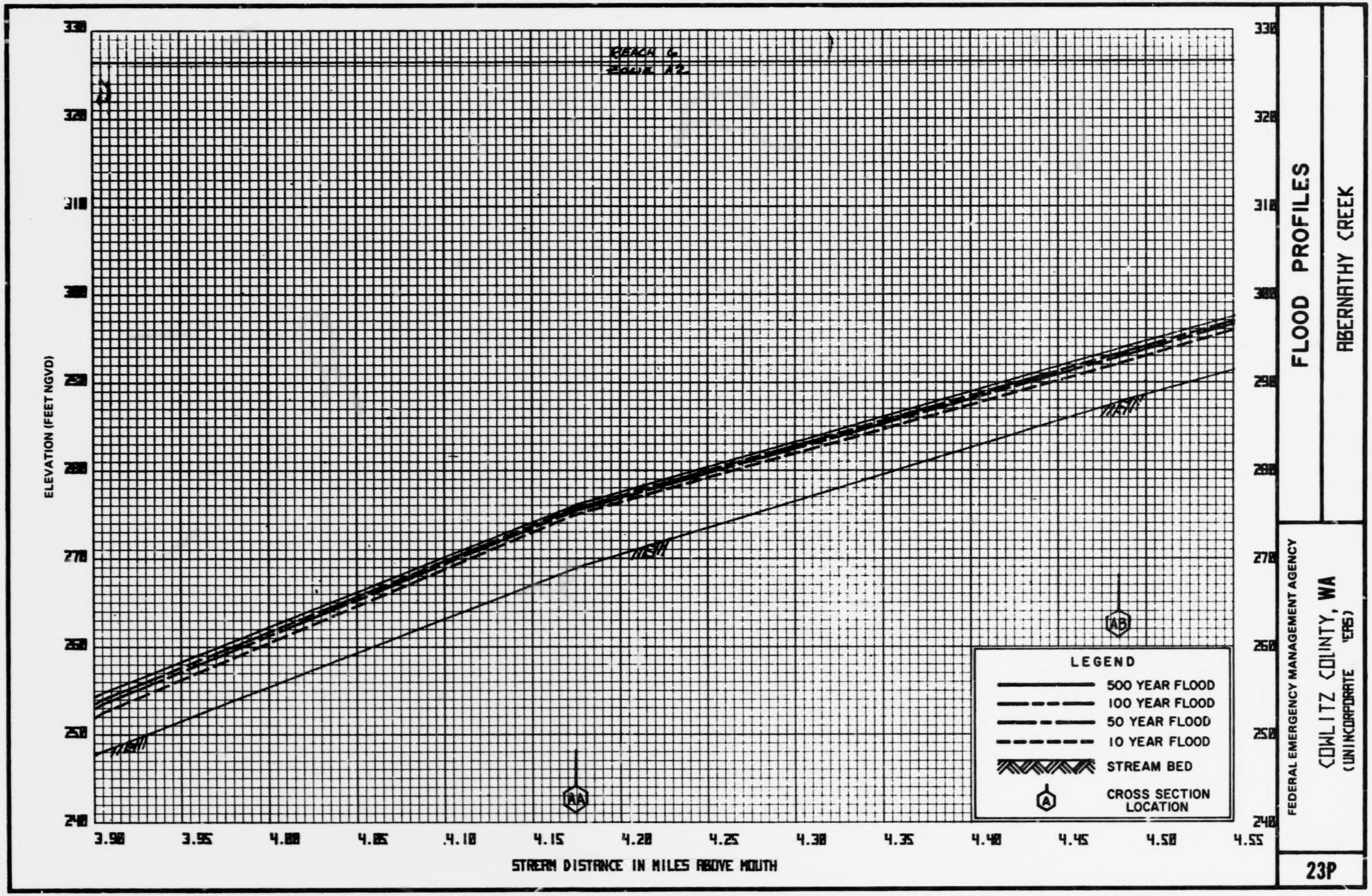
ABERNATHY CREEK

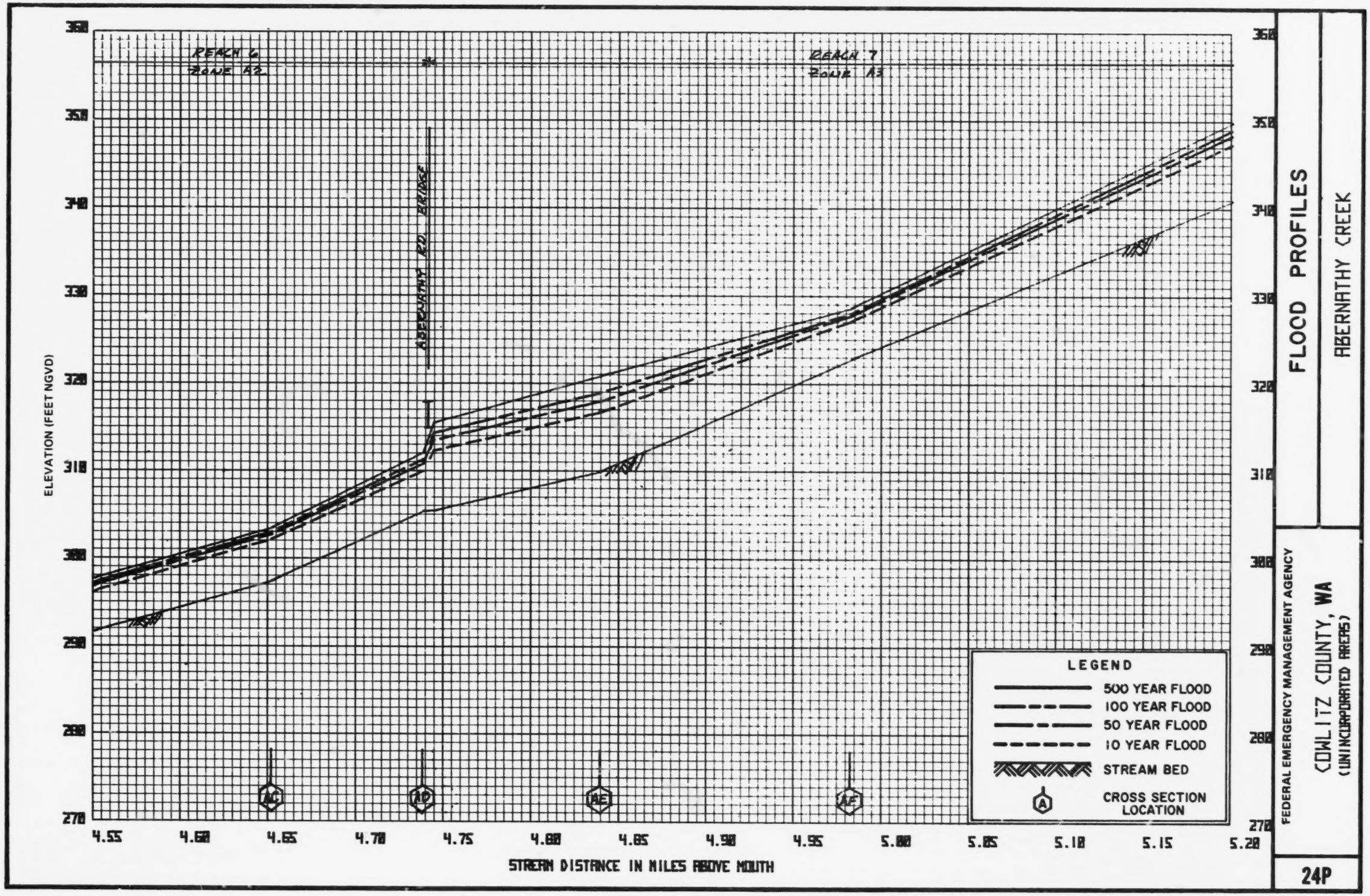
FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

22P

75


REACH 6
ZONE A2
ELEVATION (FEET NGVD)
330
320
310
300
290
280
270
260
250
240
3.90
3.95
4.00
4.05
4.10
4.15
4.20
4.25
4.30
4.35
4.40
4.45
4.50
4.55
STREAM DISTANCE IN MILES ABOVE MOUTH
AA
AB
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
A
CROSS SECTION LOCATION
FLOOD PROFILES
ABERNATHY CREEK
FEDERAL EMERGENCY MANAGEMENT AGENCY
COWLITZ COUNTY, WA
(UNINCORPORATE "EAS)
23P



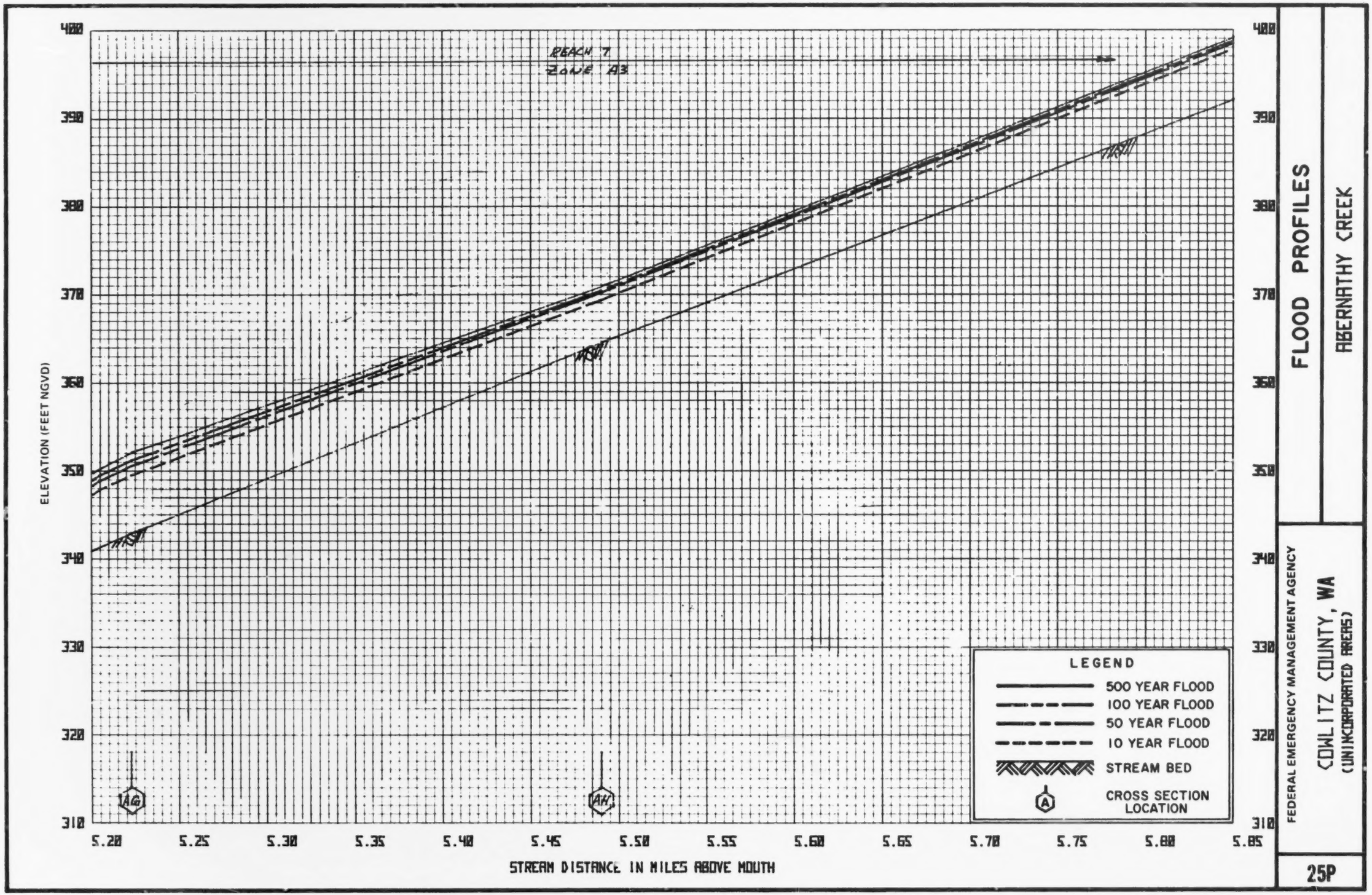
FLOOD PROFILES

ABERNATHY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

24P



FLOOD PROFILES

ABERNATHY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

25P

REACH 7
ZONE A3

ABBOTT'S POINT

ELEVATION (FEET NGVD)

450
440
430
420
410
400
390
380
370
360

5.85 5.90 5.95 6.00 6.05 6.10 6.15 6.20 6.25 6.30 6.35 6.40 6.45 6.50

STREAM DISTANCE IN MILES ABOVE MOUTH

A7

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

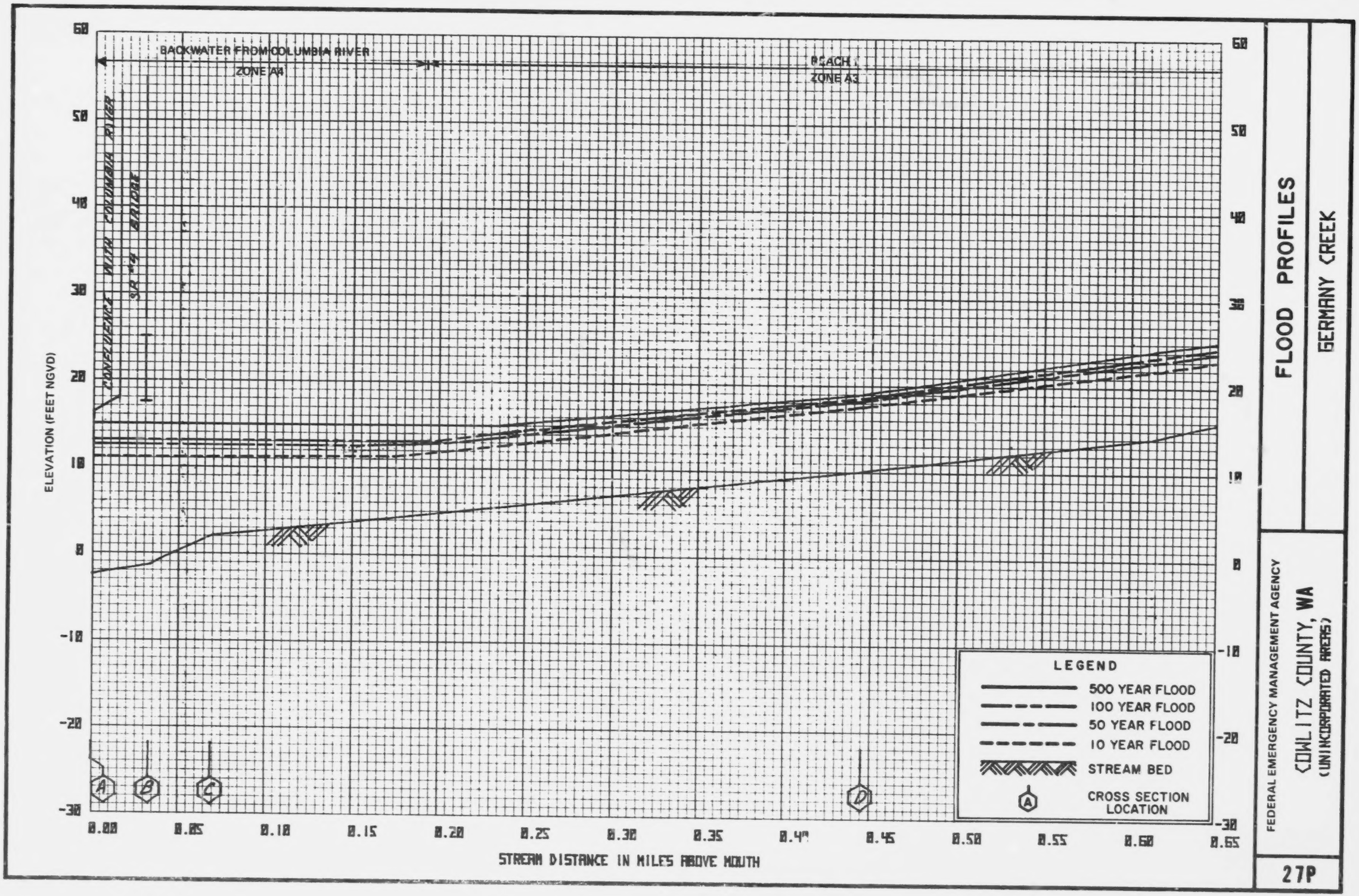
FLOOD PROFILES

ABERNATHY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

26P



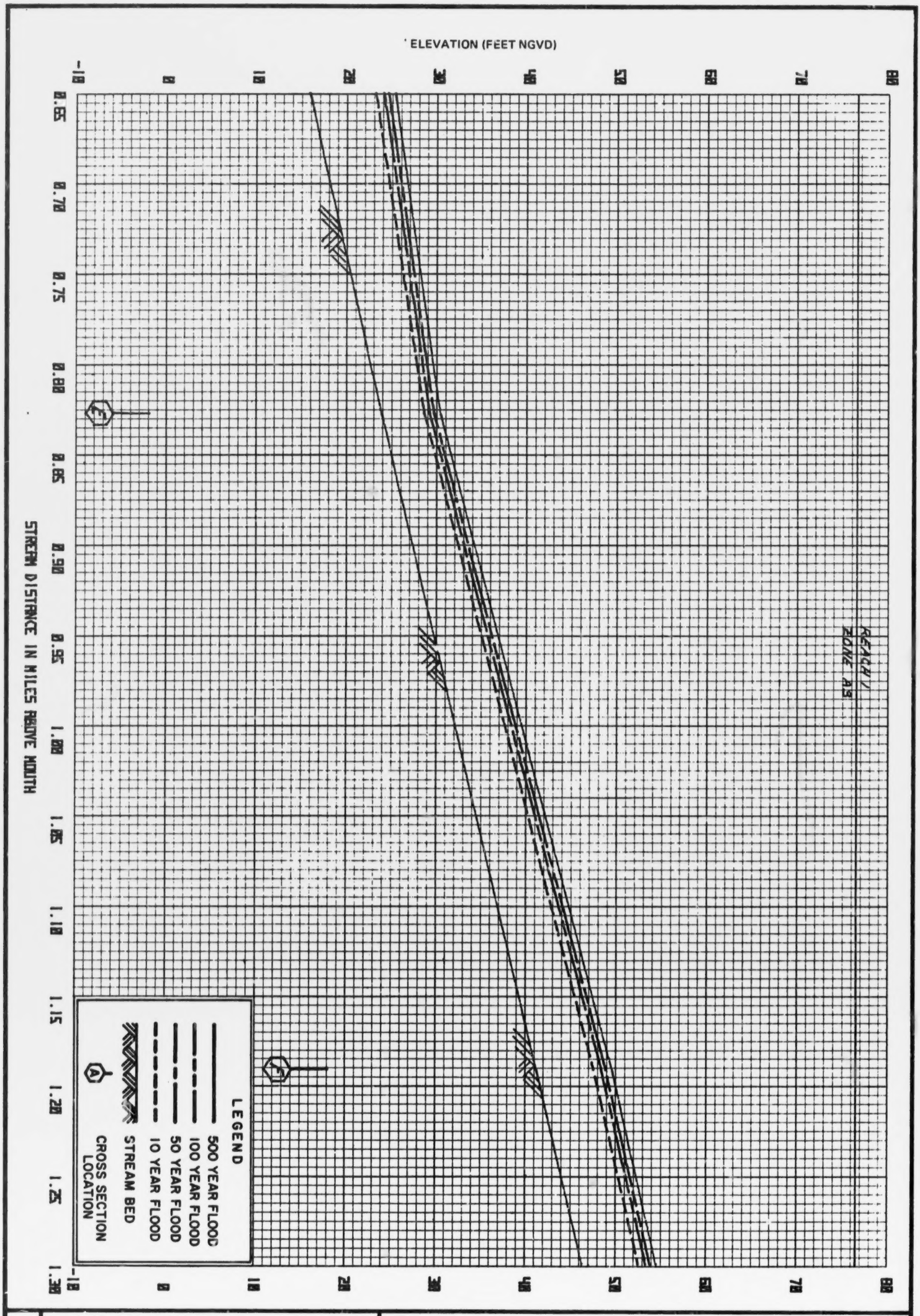
FLOOD PROFILES

GERMANY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

27P



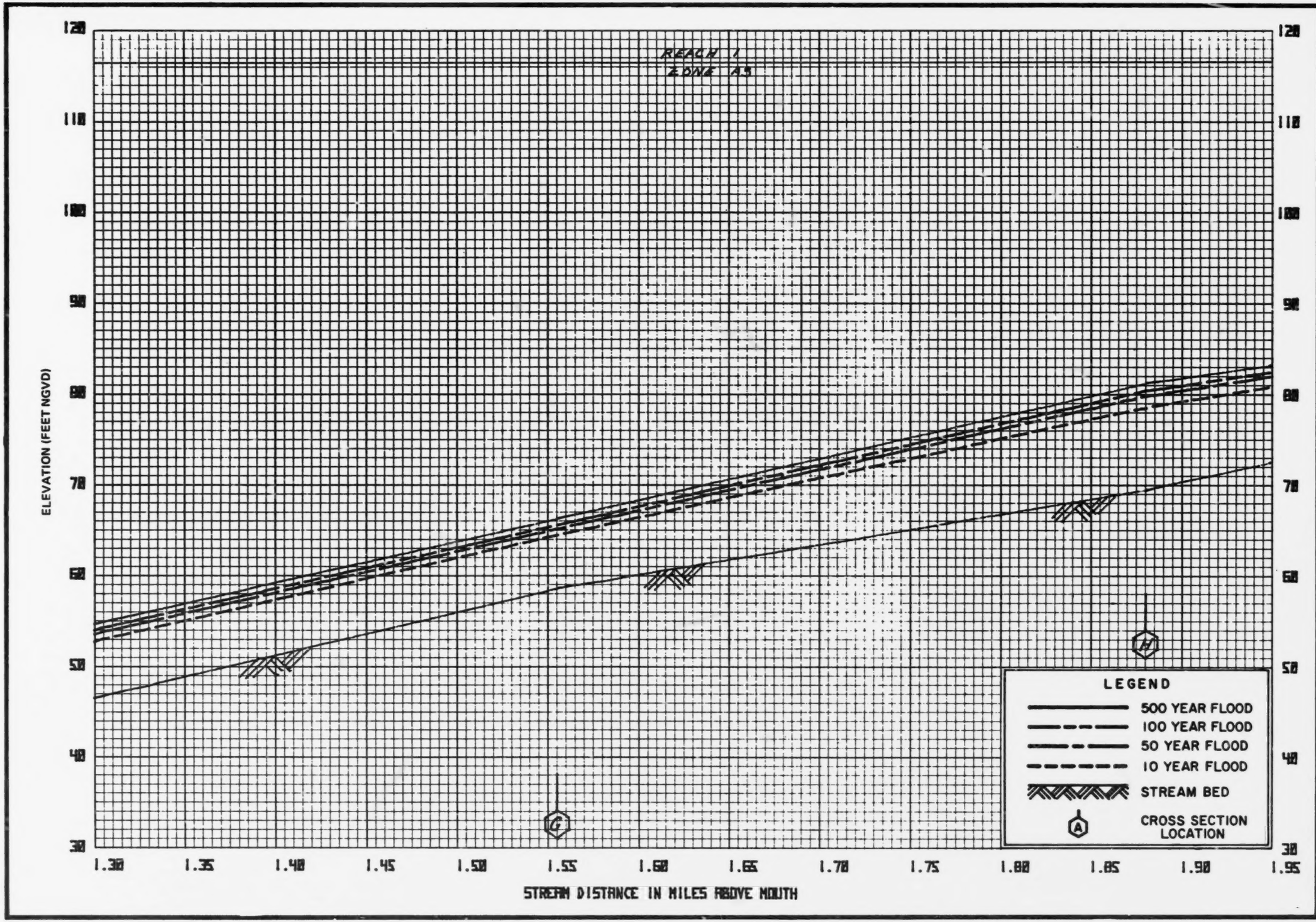
28P

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

GERMANY CREEK



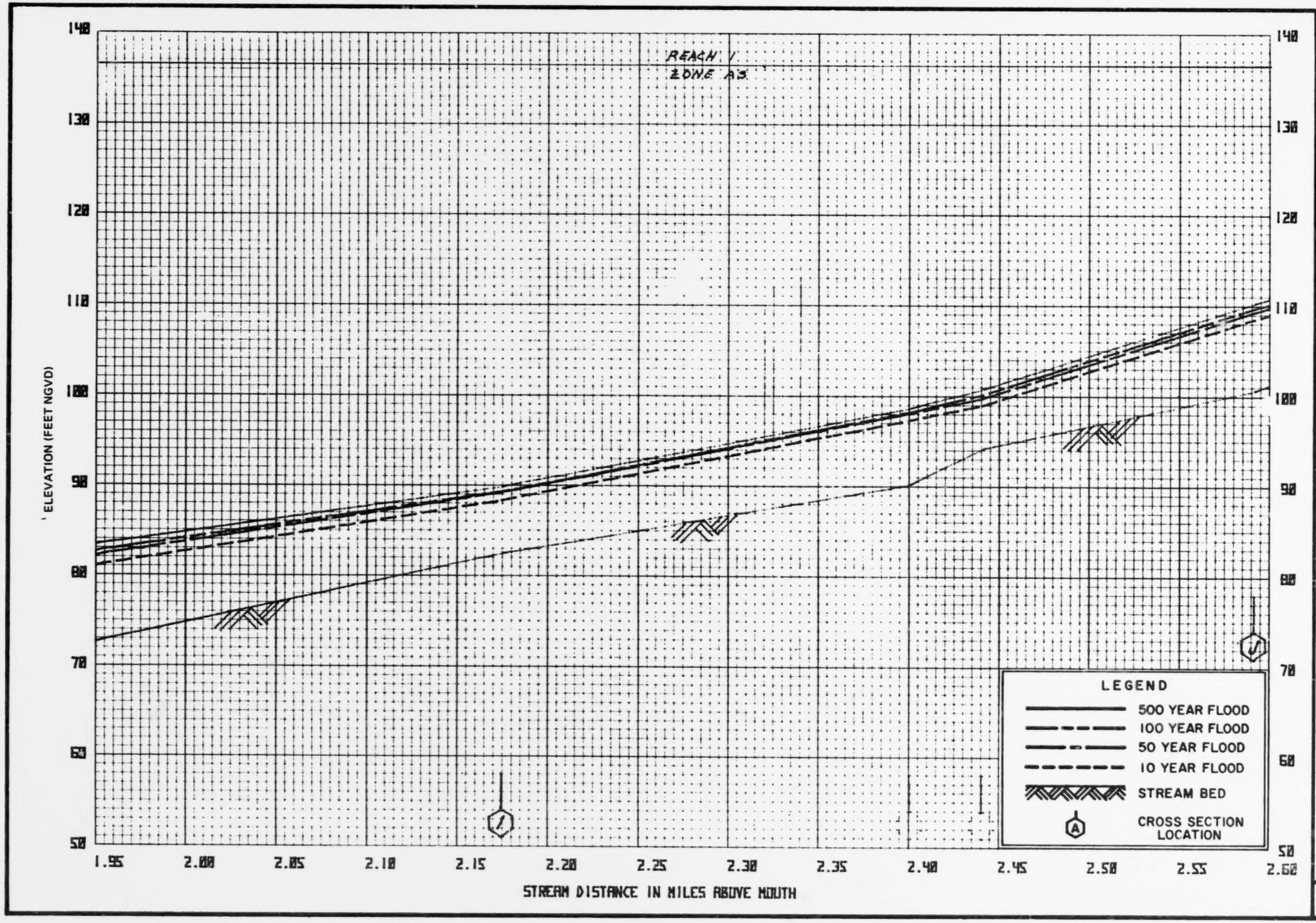
FLOOD PROFILES

GERMANY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

29P



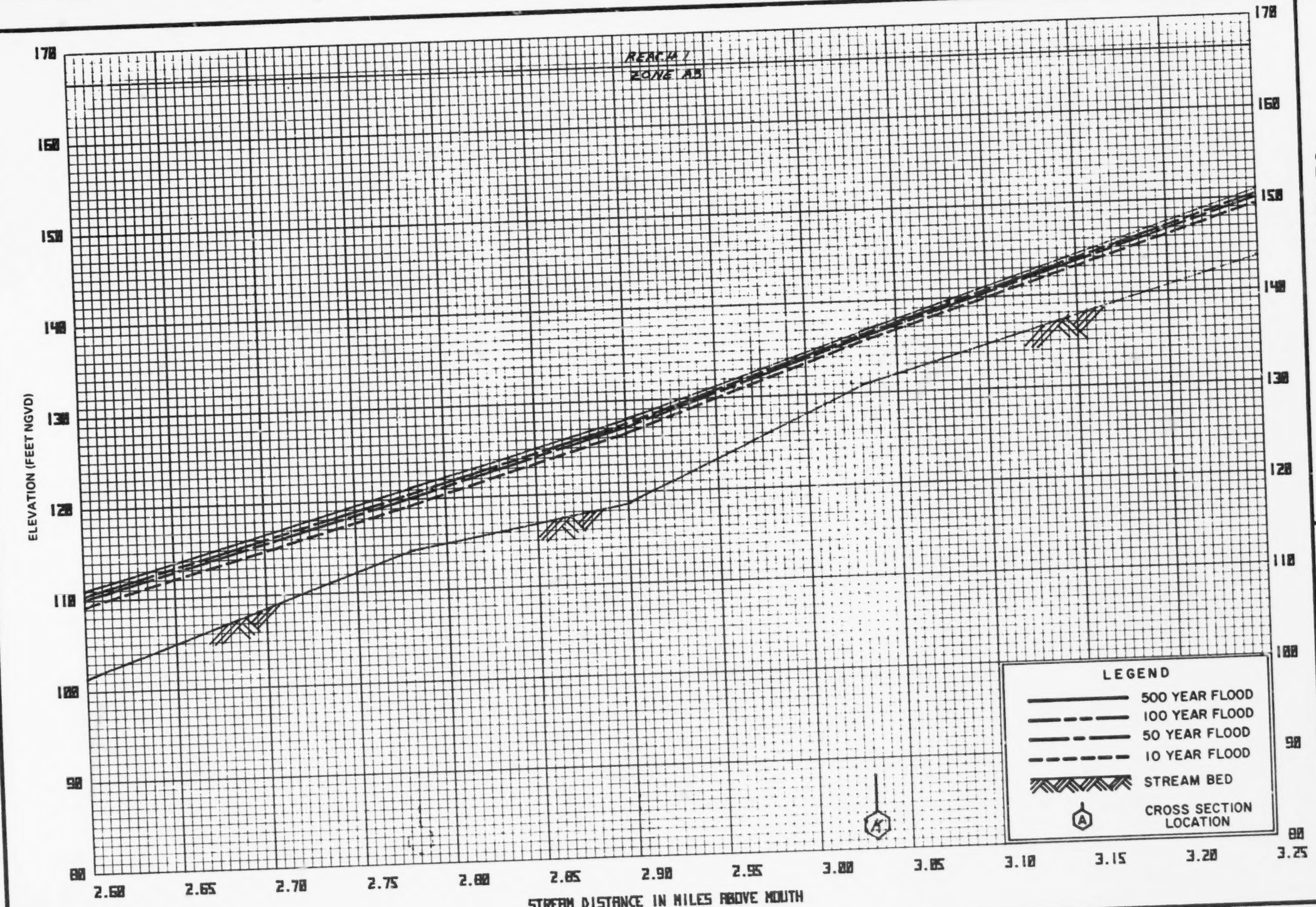
FLOOD PROFILES

GERMANY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

30P



FLOOD PROFILES

GERMANY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

31P

84

REACH 1
ZONE A1

ELEVATION (FEET NGVD)

210
200
190
180
170
160
150
140
130
120

3.25 3.30 3.35 3.40 3.45 3.50 3.55 3.60 3.65 3.70 3.75 3.80 3.85 3.90

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

GERMANY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

32P

REACH 1
ZONE A5

240
230
220
210
200
190
180
170
160
150

ELEVATION (FEET NGVD)

3.90 3.95 4.00 4.05 4.10 4.15 4.20 4.25 4.30 4.35 4.40 4.45 4.50 4.55

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

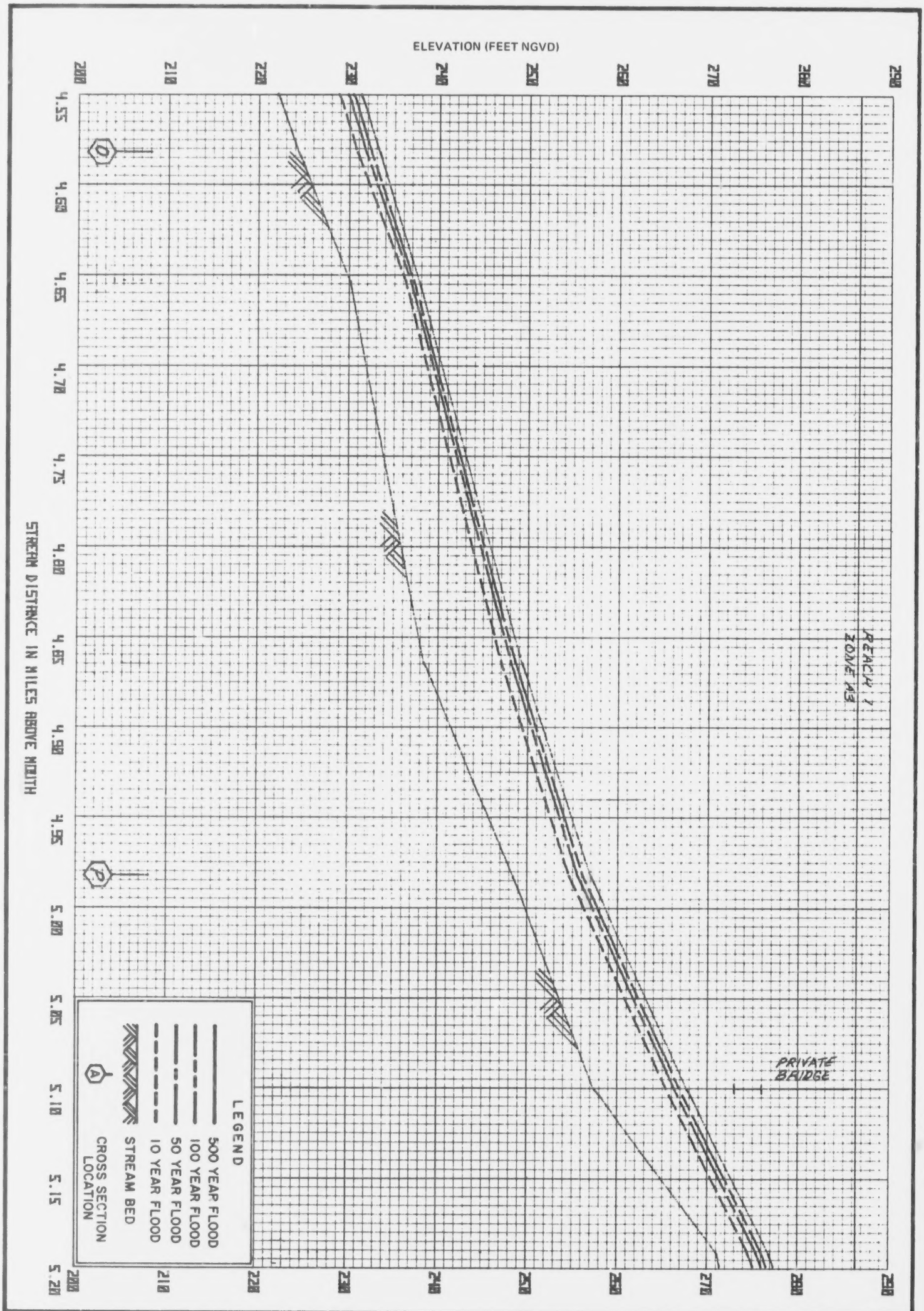
GERMANY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

33P

86



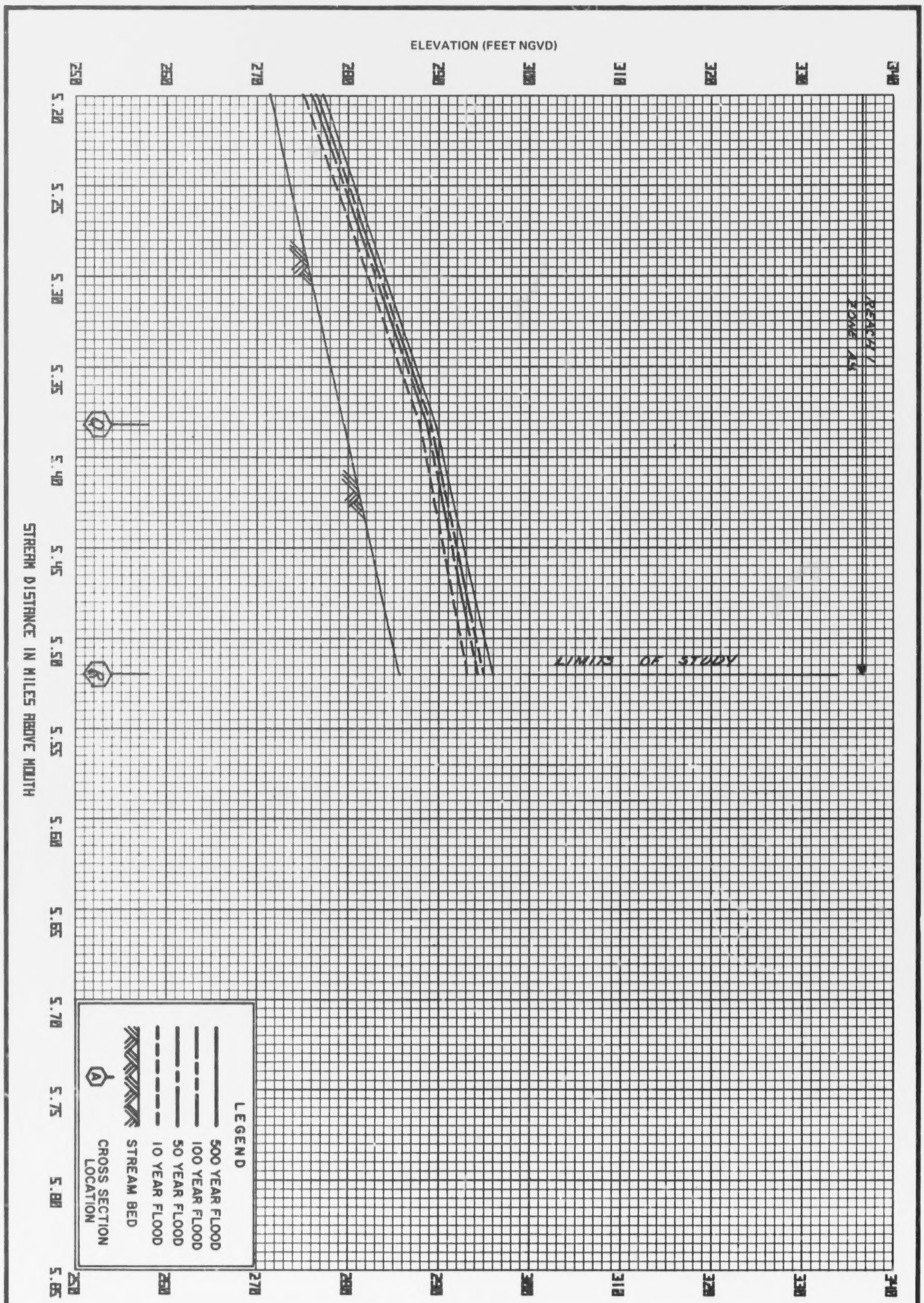
34P

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

GERMANY CREEK



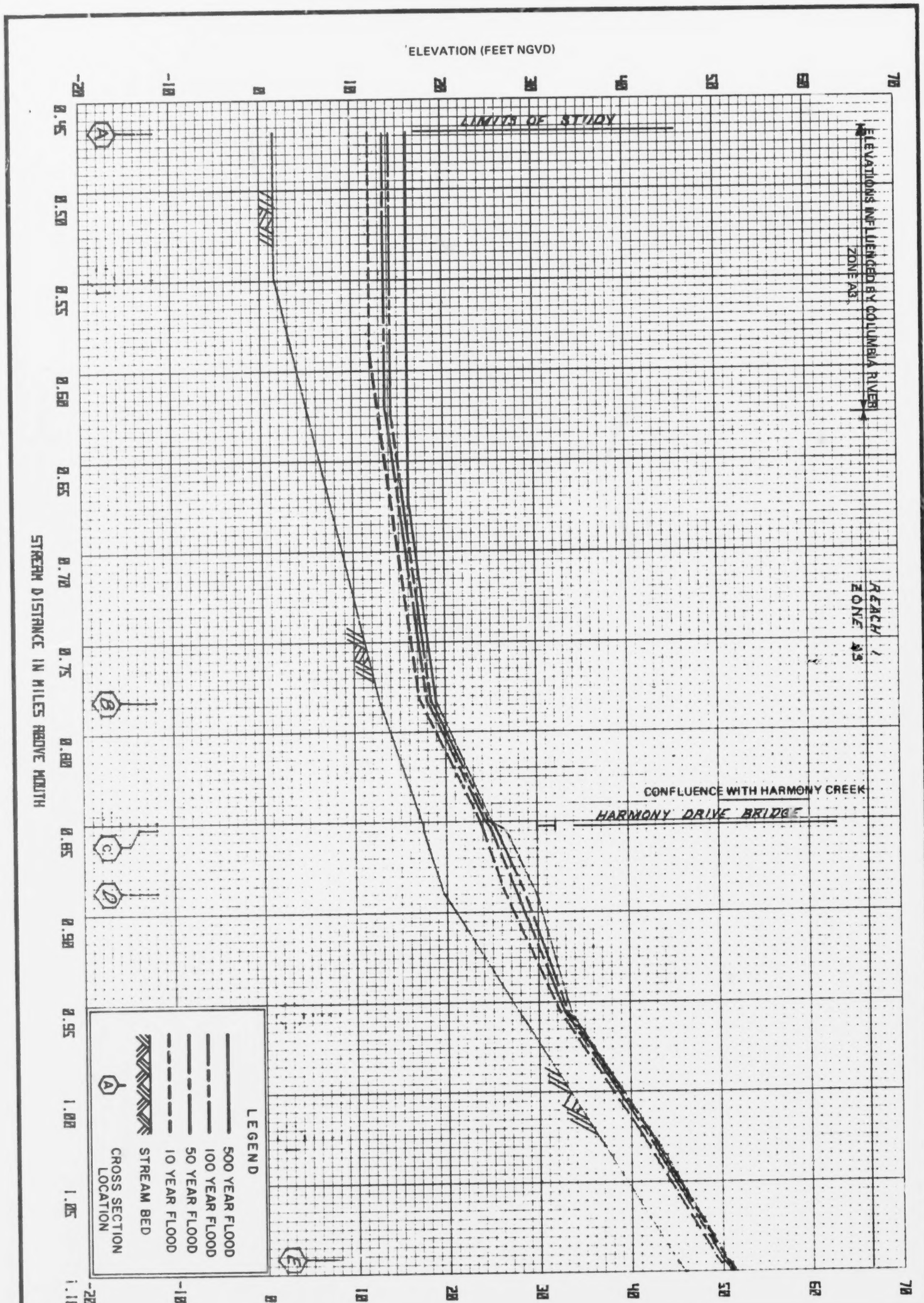
35P

FEDERAL EMERGENCY MANAGEMENT AGENCY

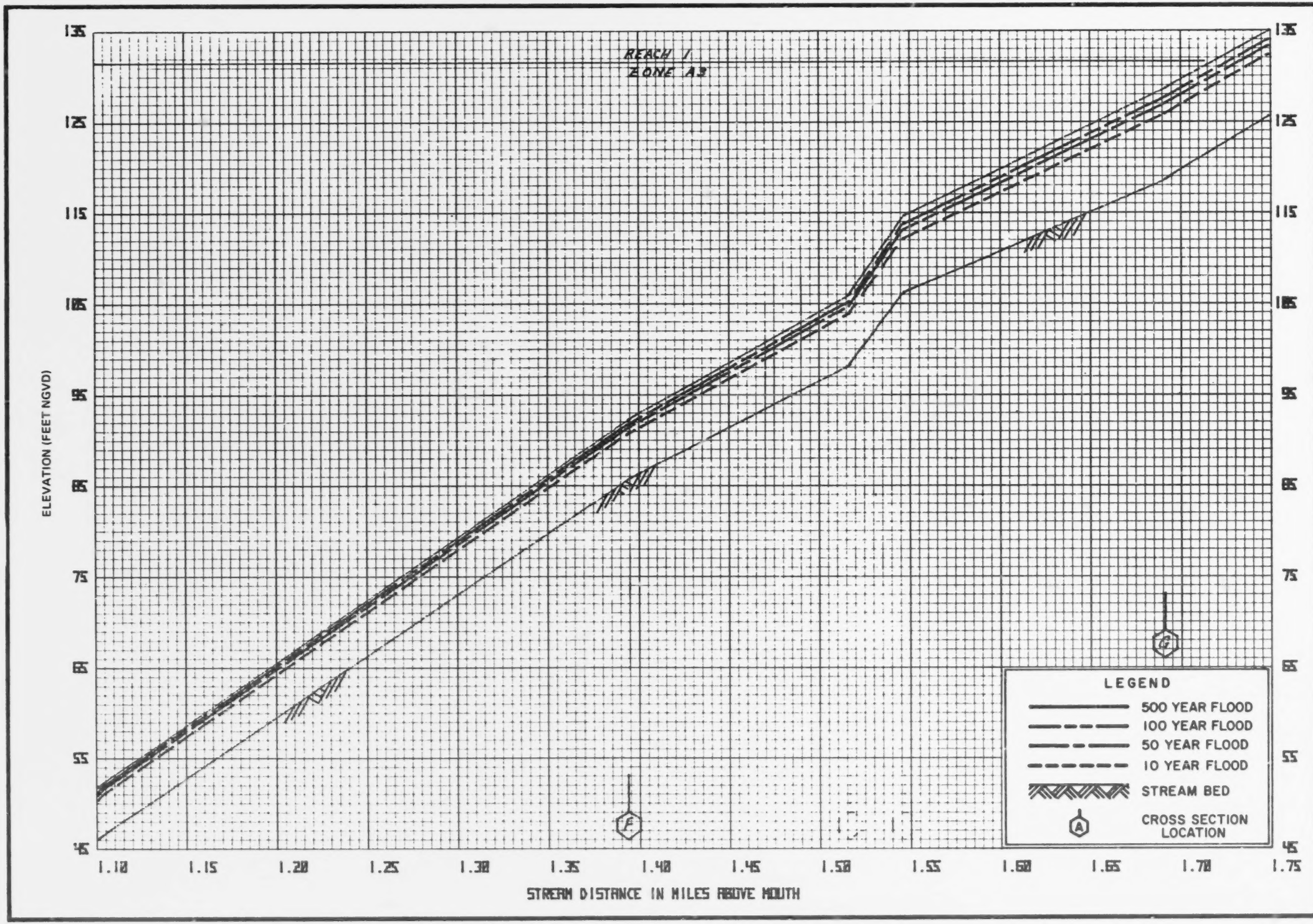
COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

GERMANY CREEK



36P	FEDERAL EMERGENCY MANAGEMENT AGENCY COWLITZ COUNTY, WA (UNINCORPORATED AREA)	FLOOD PROFILES COAL CREEK



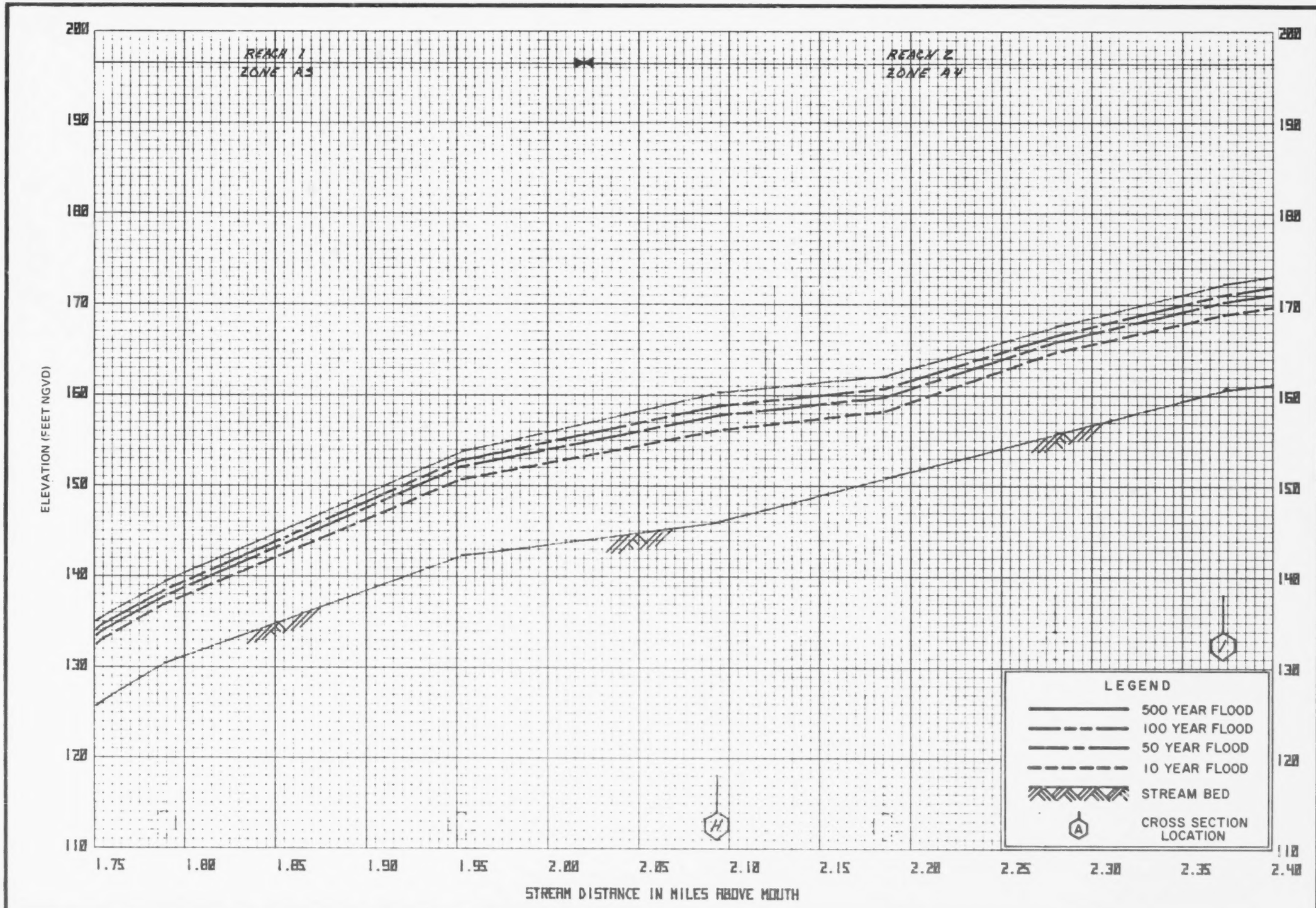
FLOOD PROFILES

COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

37P



FLOOD PROFILES

COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

38P

REACH 2
ZONE A4

ELEVATION (FEET NGVD)

230
220
210
200
190
180
170
160
150
140

2.40 2.45 2.50 2.55 2.60 2.65 2.70 2.75 2.80 2.85 2.90 2.95 3.00 3.05

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

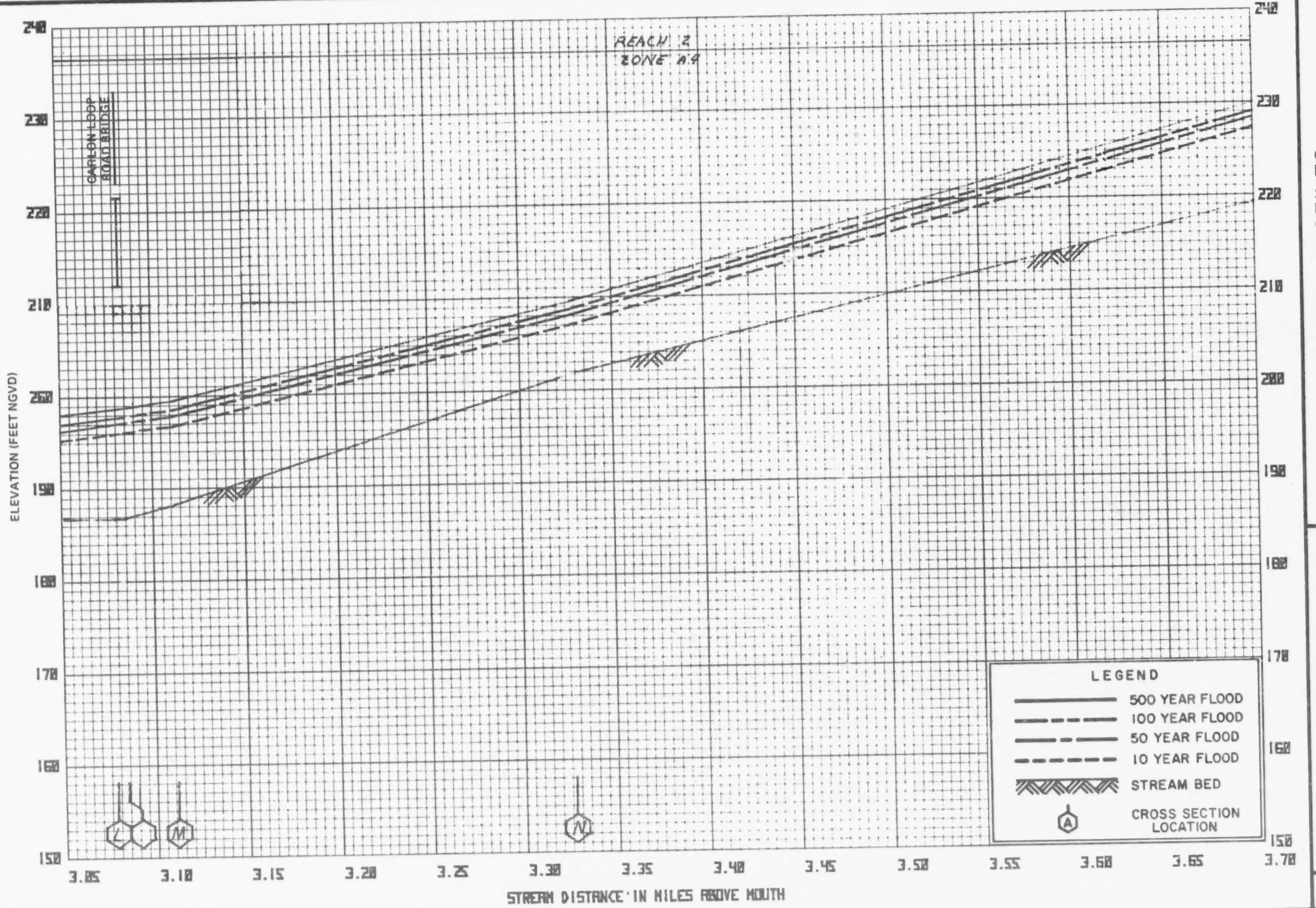
FLOOD PROFILES

COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

39P



FLOOD PROFILES

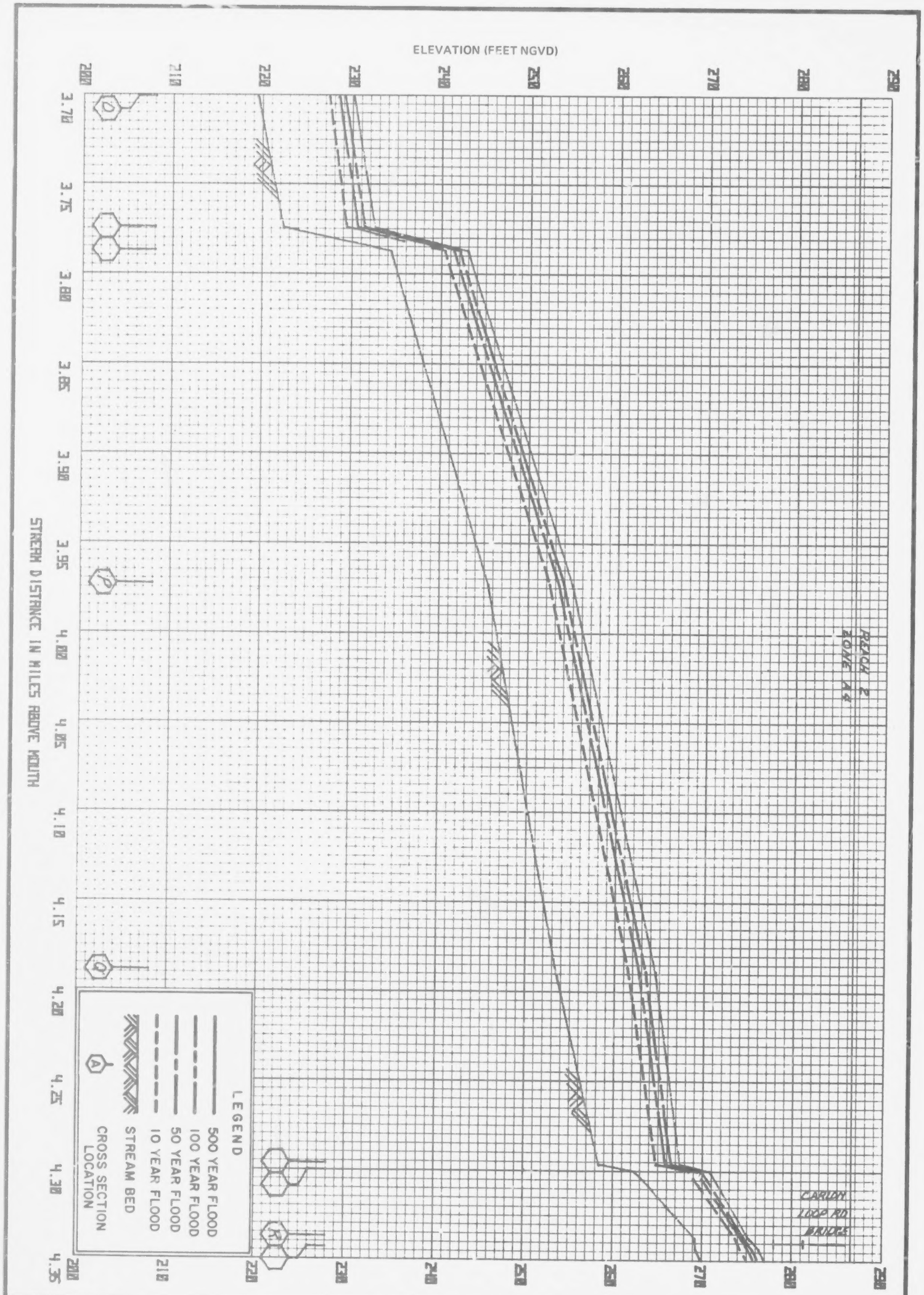
COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

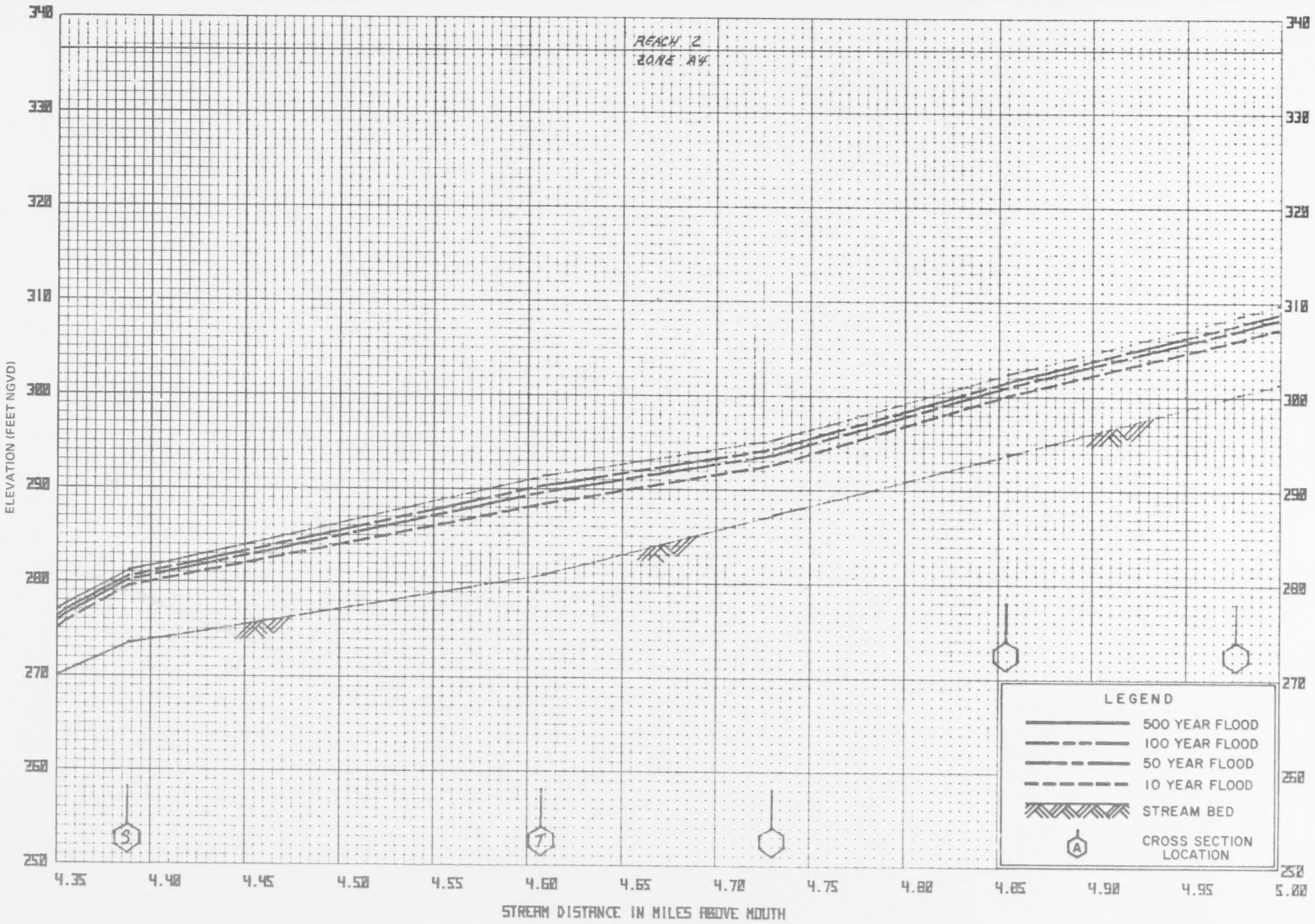
COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

40P

93



41P	FEDERAL EMERGENCY MANAGEMENT AGENCY COWLITZ COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES COAL CREEK



FLOOD PROFILES

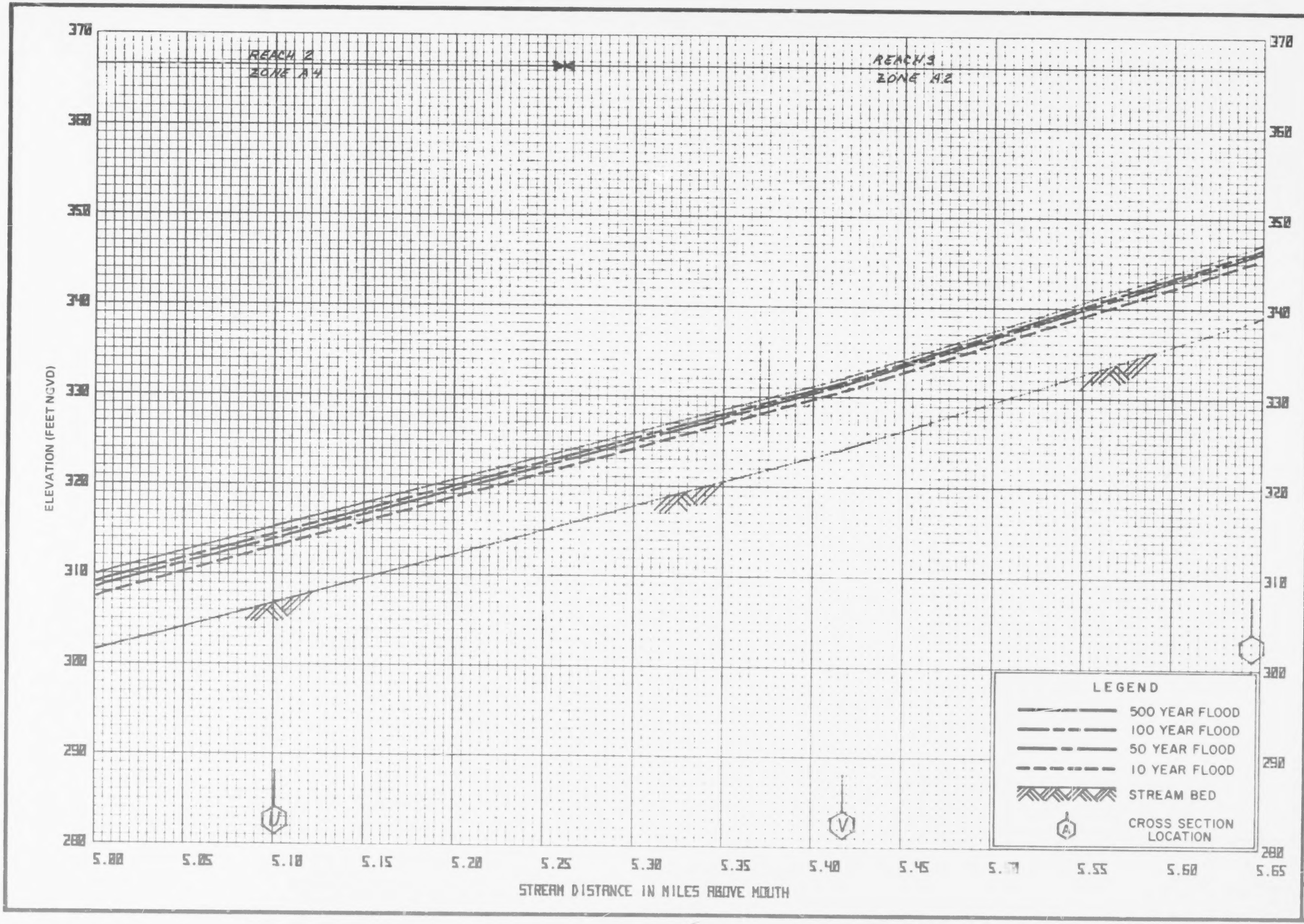
COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

42P

55



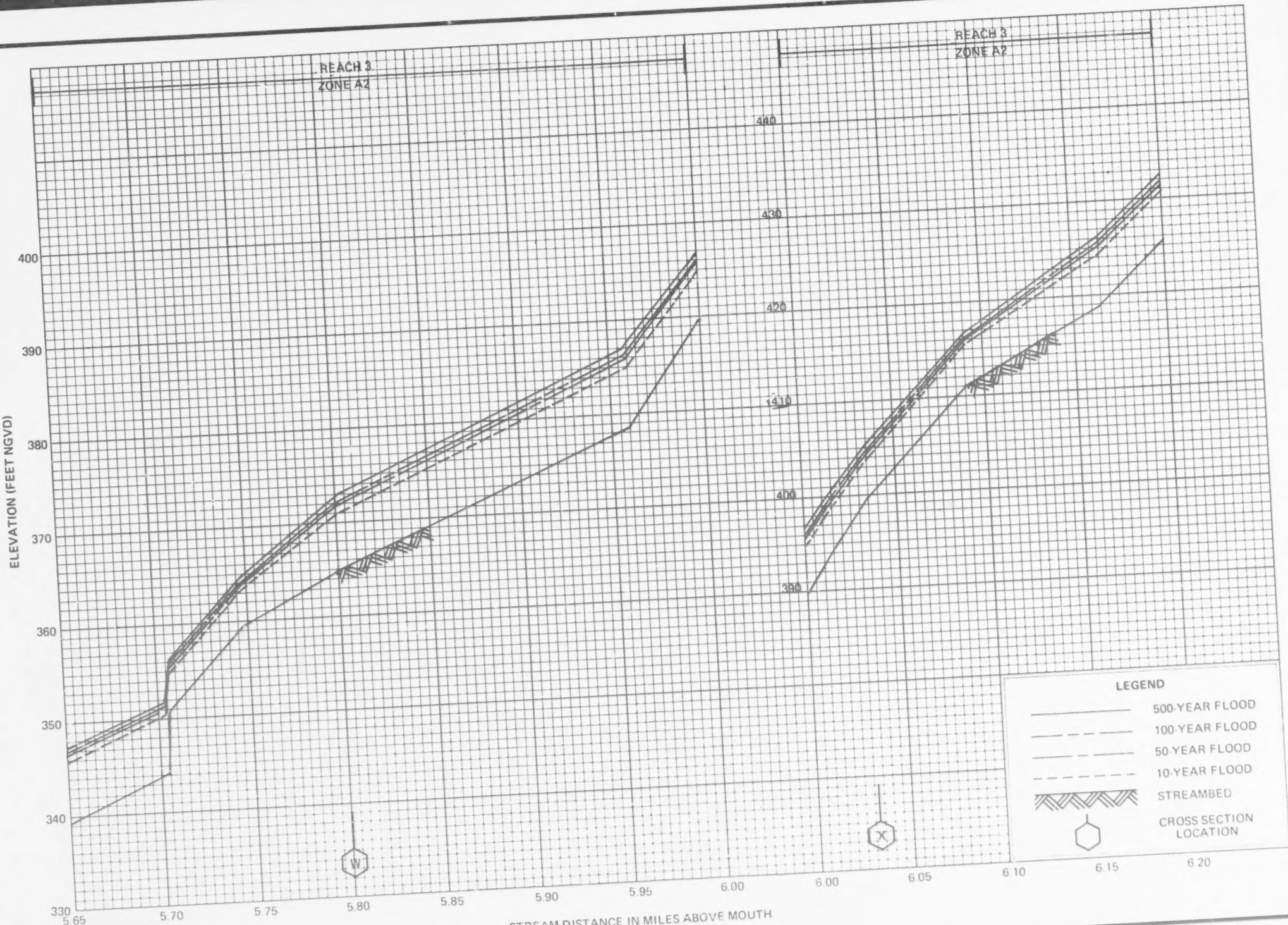
FLOOD PROFILES

COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

43P



FLOOD PROFILES

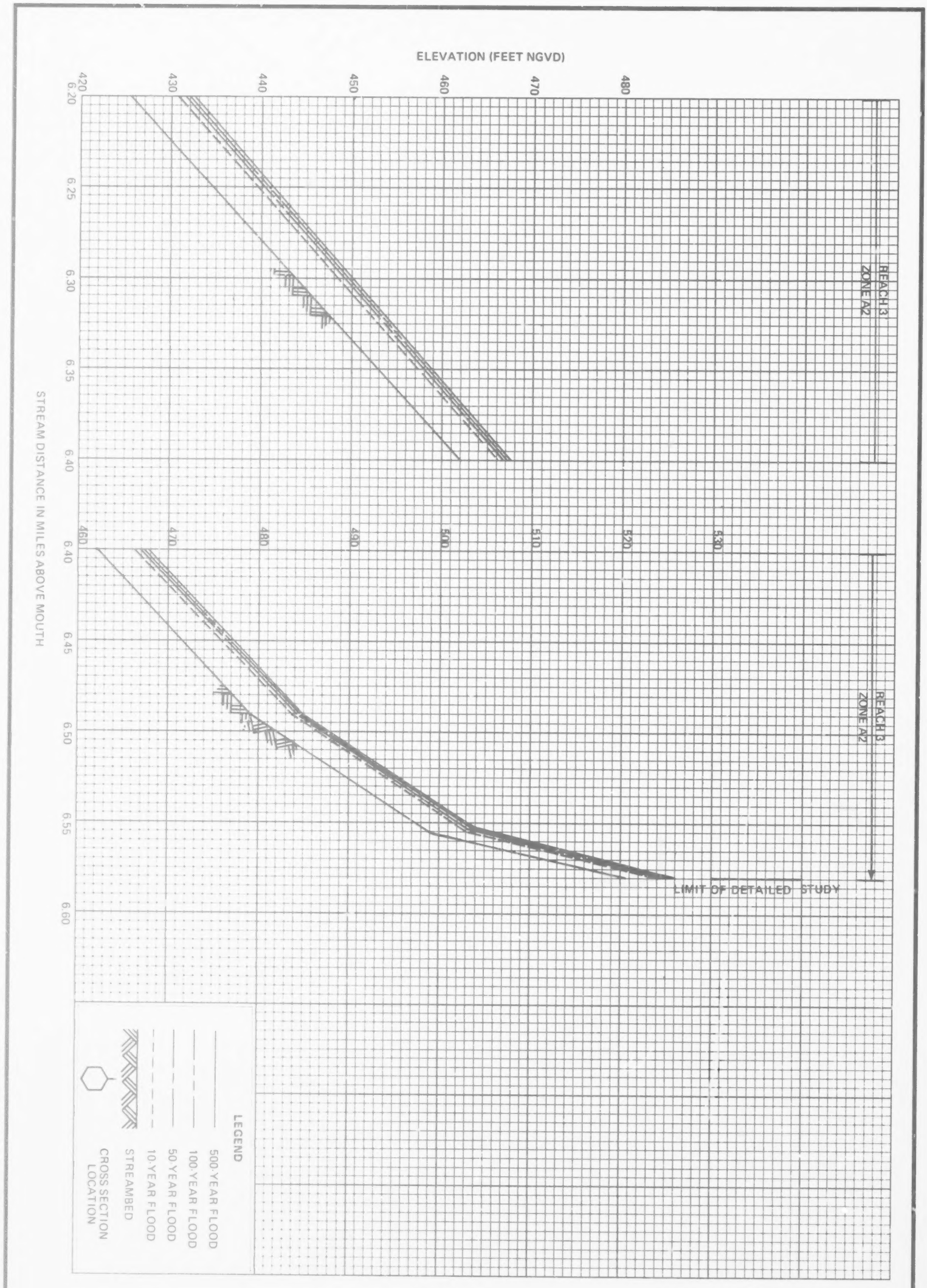
COAL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINCORPORATED AREAS)

44P



45P

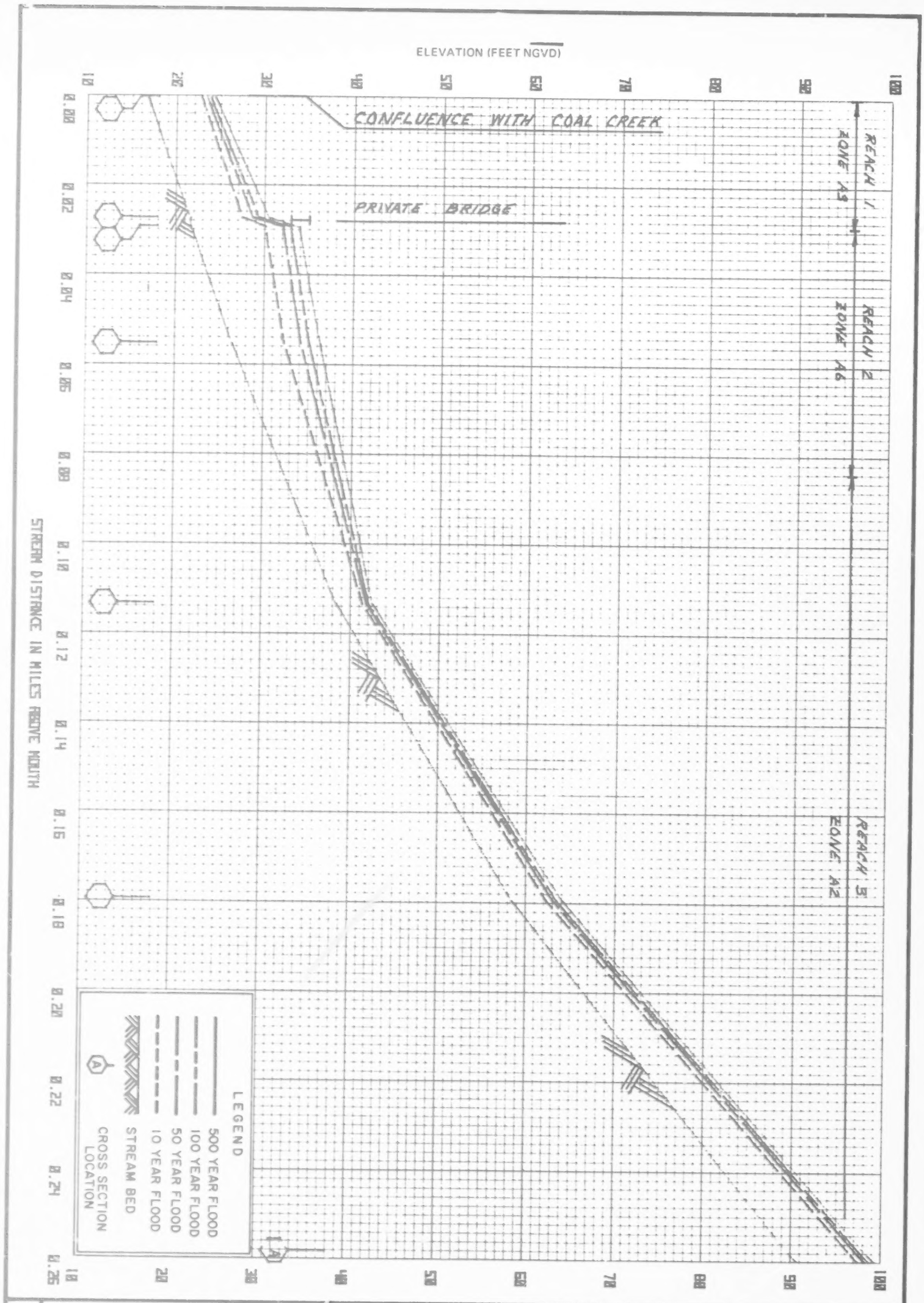
FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

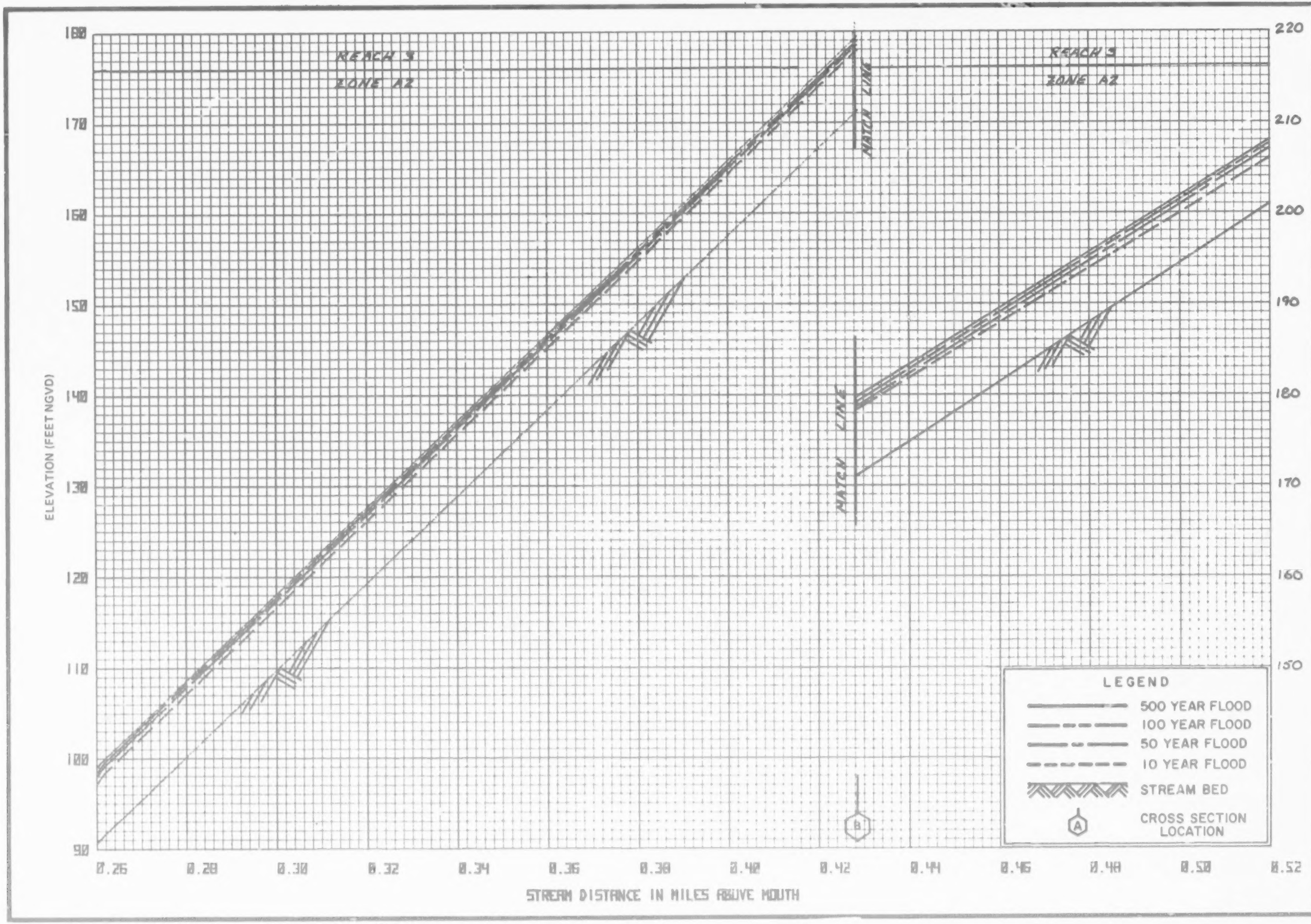
(UNINCORPORATED AREAS)

FLOOD PROFILES

COAL CREEK



46P	FEDERAL EMERGENCY MANAGEMENT AGENCY COWLITZ COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES HARMONY CREEK



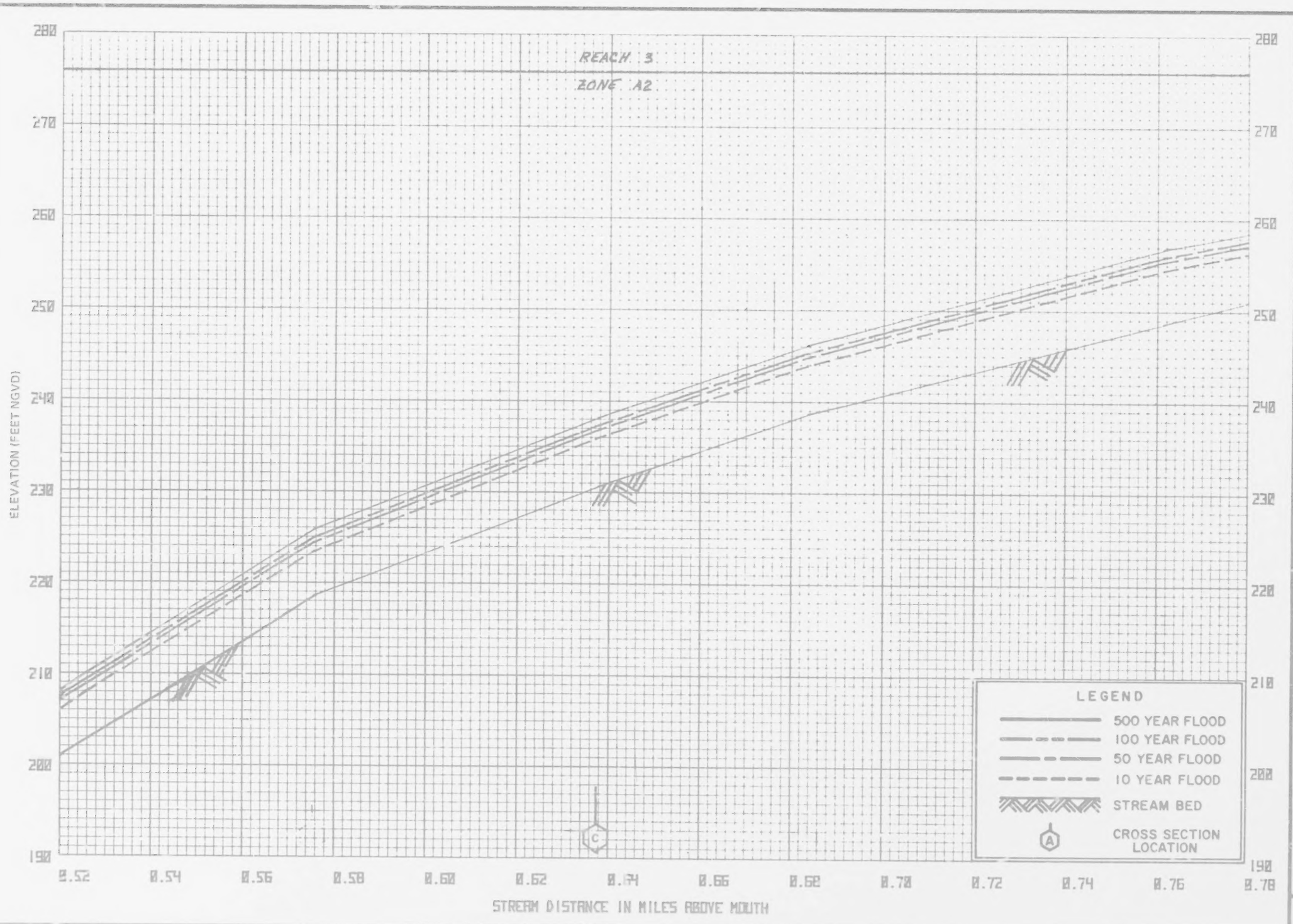
FLOOD PROFILES

HARMONY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

47P



FLOOD PROFILES

HARMONY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINCORPORATED AREAS)

48P

REACH 3
ZONE A2

ELEVATION (FEET NGVD)

320
310
300
290
280
270
260
250
240
230

0.78 0.80 0.82 0.84 0.86 0.88 0.90 0.92 0.94 0.96 0.98 1.00 1.02 1.04

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND

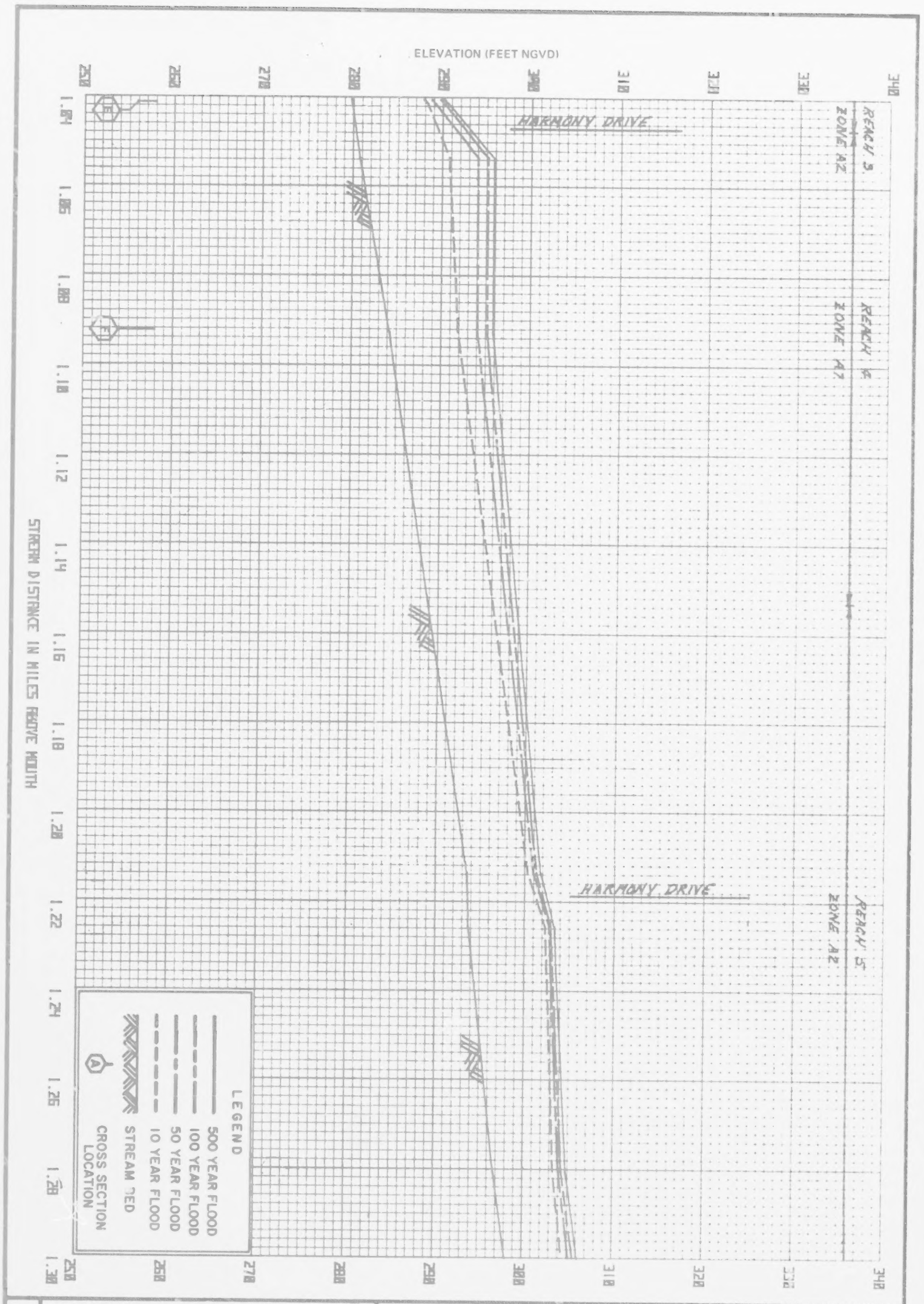
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION (A)

FLOOD PROFILES

HARMONY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)



50P

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

HARMONY CREEK

REACH 5

ZONE A2

PRIVATE BRIDGE

ELEVATION (FEET NGVD)

360
350
340
330
320
310
300
290
280
270

1.30 1.32 1.34 1.36 1.38 1.40 1.42 1.44 1.46 1.48 1.50 1.52 1.54 1.56

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION (A)

FLOOD PROFILES

HARMONY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINCORPORATED AREAS)

51P

REACH 5

ZONE A2

PRIVATE ROADWAY

ELEVATION (FEET NGVD)

370
360
350
340
330
320
310
300
290

1.56 1.58 1.60 1.62 1.64 1.66 1.68 1.70 1.72 1.74 1.76 1.78 1.80 1.82

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION (A)

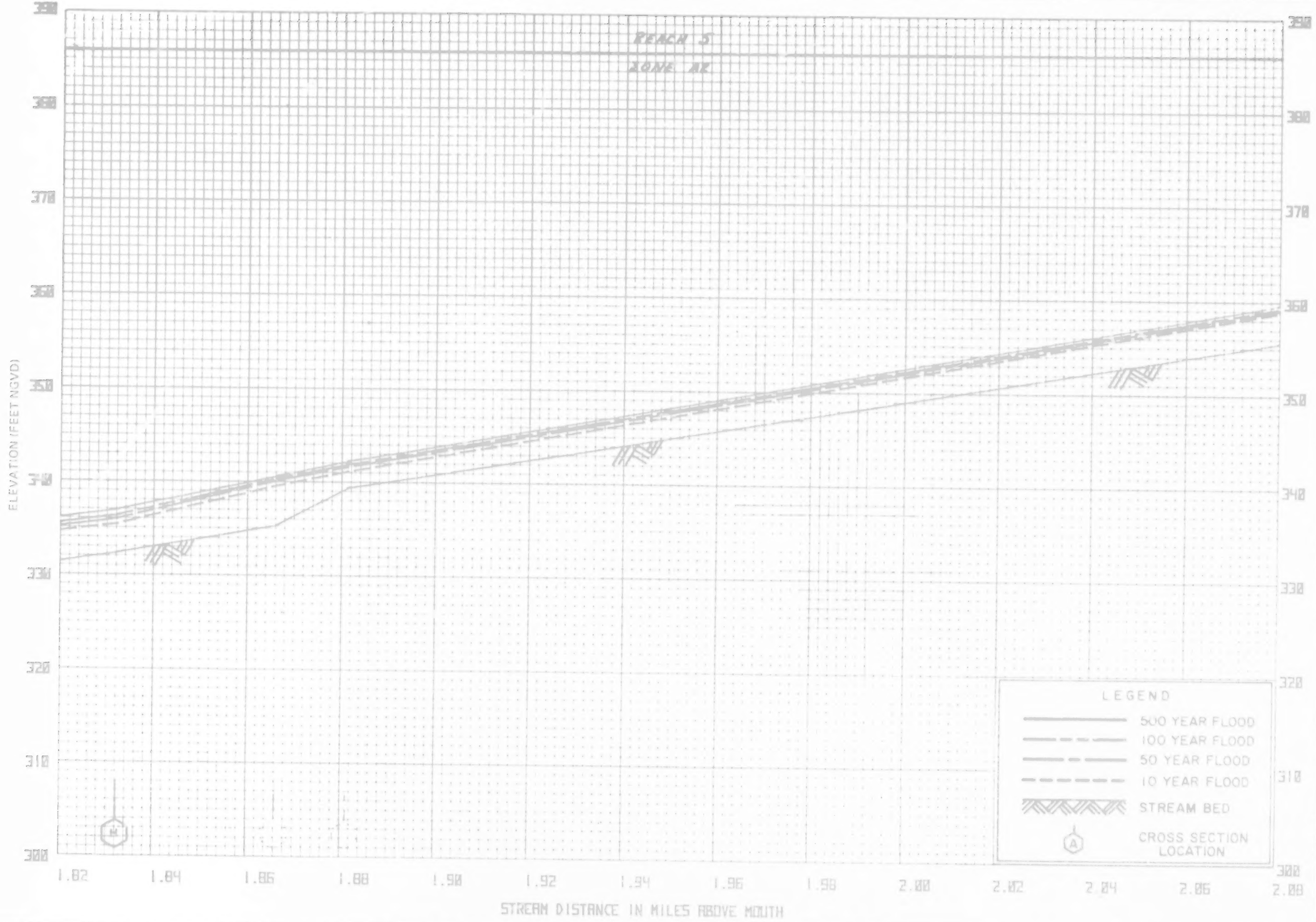
FLOOD PROFILES

HARMONY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

52P



FLOOD PROFILES

HARMONY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

53P

ELEVATION (FEET NGVD)

410
400
390
380
370
360
350
340
330
320

REACH B
ZONE A2
LIMIT OF DETAILED STUDY

LEGEND
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

2.08 2.10 2.12 2.14 2.16 2.18 2.20 2.22 2.24 2.26 2.28 2.30 2.32 2.34

STREAM DISTANCE IN MILES ABOVE MOUTH

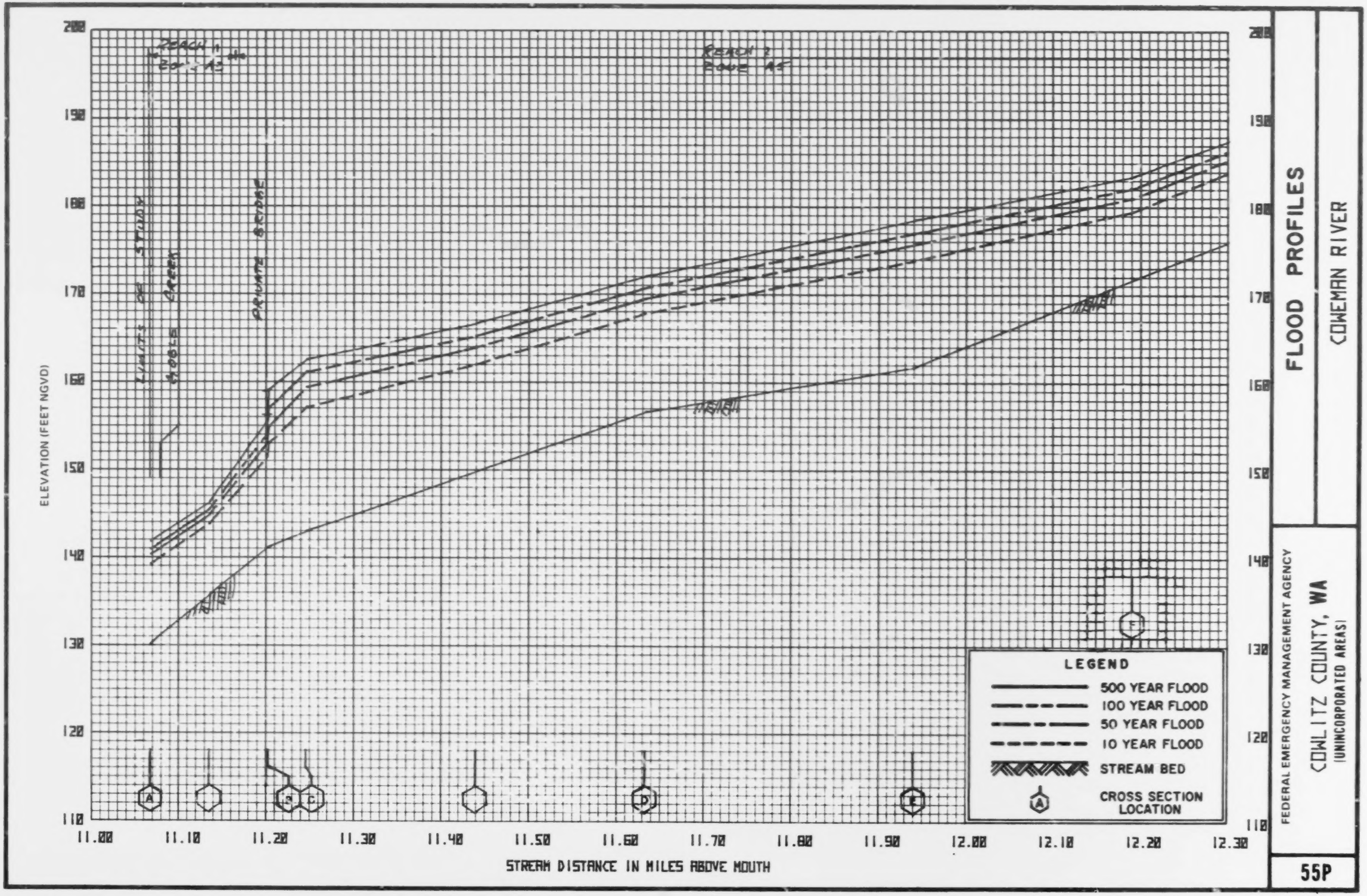
FLOOD PROFILES

HARMONY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

54P



FLOOD PROFILES

COWEMAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

55P

REACH 21
ZONE A5

PREVIOUS BRIDGE

ELEVATION (FEET NGVD)

250
240
230
220
210
200
190
180
170
160

12.30 12.40 12.50 12.60 12.70 12.80 12.90 13.00 13.10 13.20 13.30 13.40 13.50 13.60

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

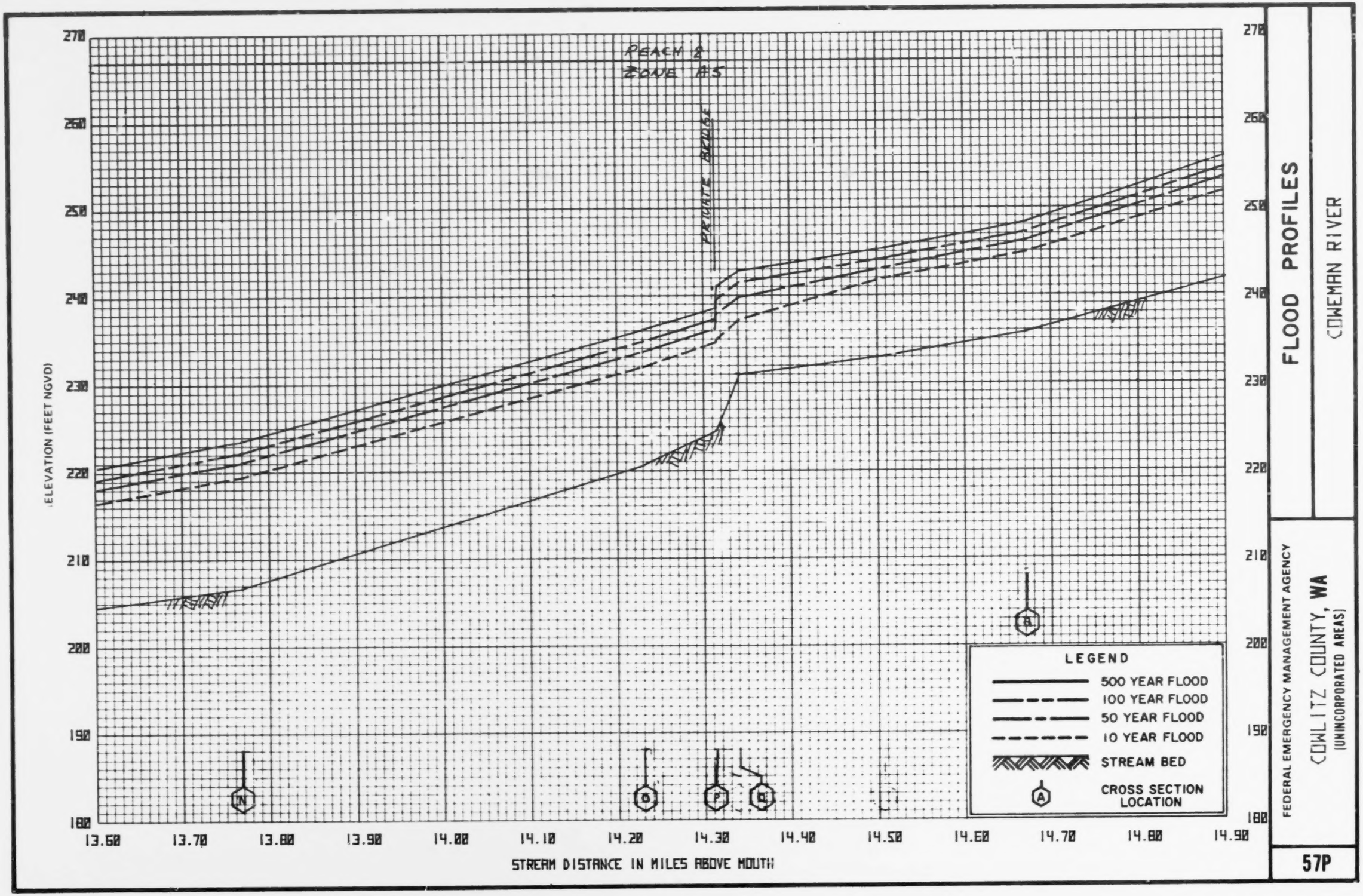
FLOOD PROFILES

COWEMAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

56P



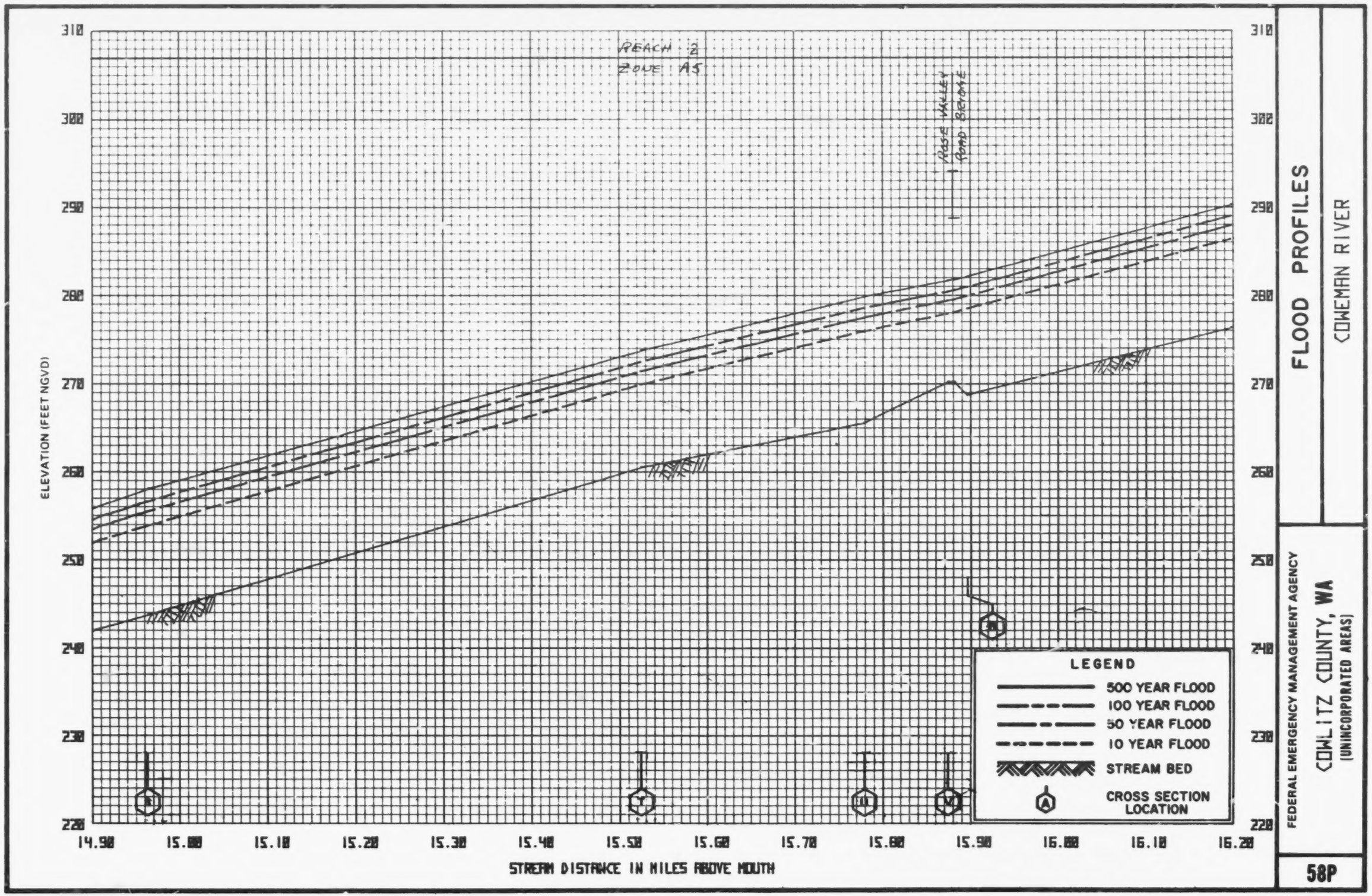
FLOOD PROFILES

COWEMAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

57P



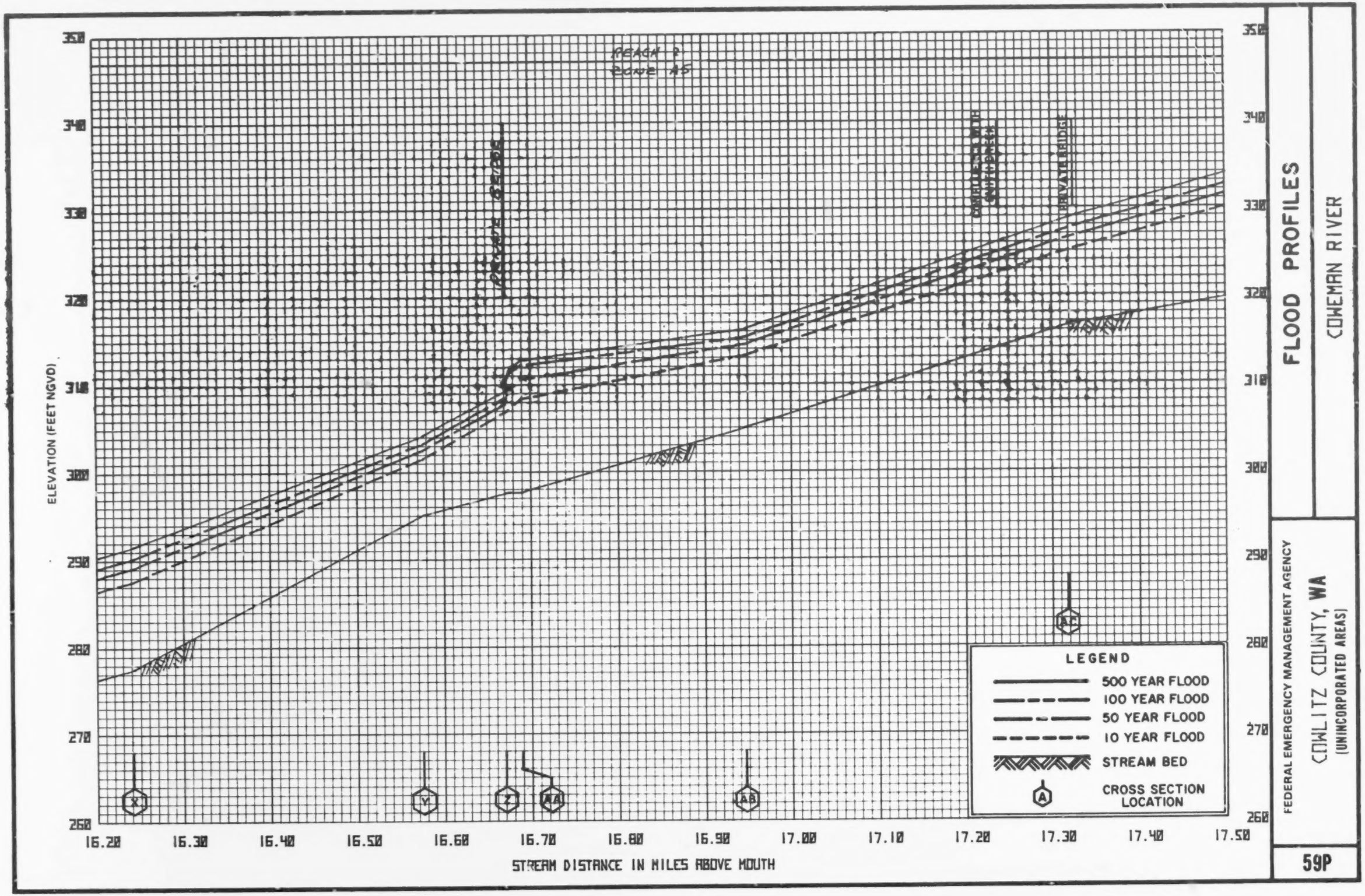
FLOOD PROFILES

COWEMAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

58P



FLOOD PROFILES

COWEMAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

59P

PEACH-T-2
ZONE AE

LIMITS OF STUDY

ELEVATION (FEET NGVD)

390
380
370
360
350
340
330
320
310
300

17.50 17.60 17.70 17.80 17.90 18.00 18.10 18.20 18.30 18.40 18.50 18.60 18.70 18.80

STREAM DISTANCE IN MILES ABOVE MOUTH

A1 A2 A3 A4

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- (A) CROSS SECTION LOCATION

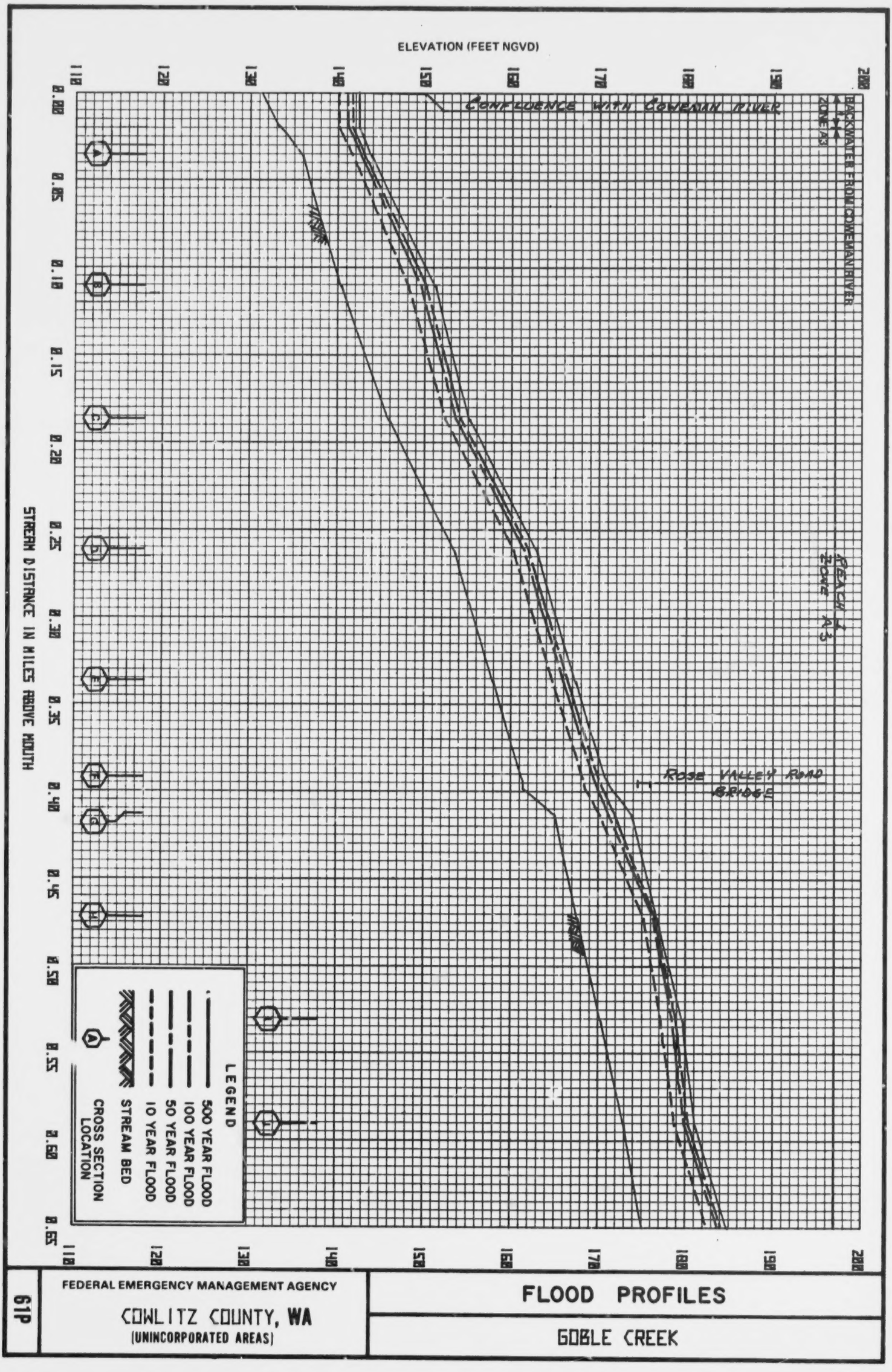
FLOOD PROFILES

COWEMAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

60P



61P

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

GOBLE CREEK

REACH 1
ZONE AE

ELEVATION (FEET NGVD)

250
240
230
220
210
200
190
180
170
160

0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00 1.05 1.10 1.15 1.20 1.25 1.30

STREAM DISTANCE IN MILES ABOVE MOUTH

K L M N O P Q

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

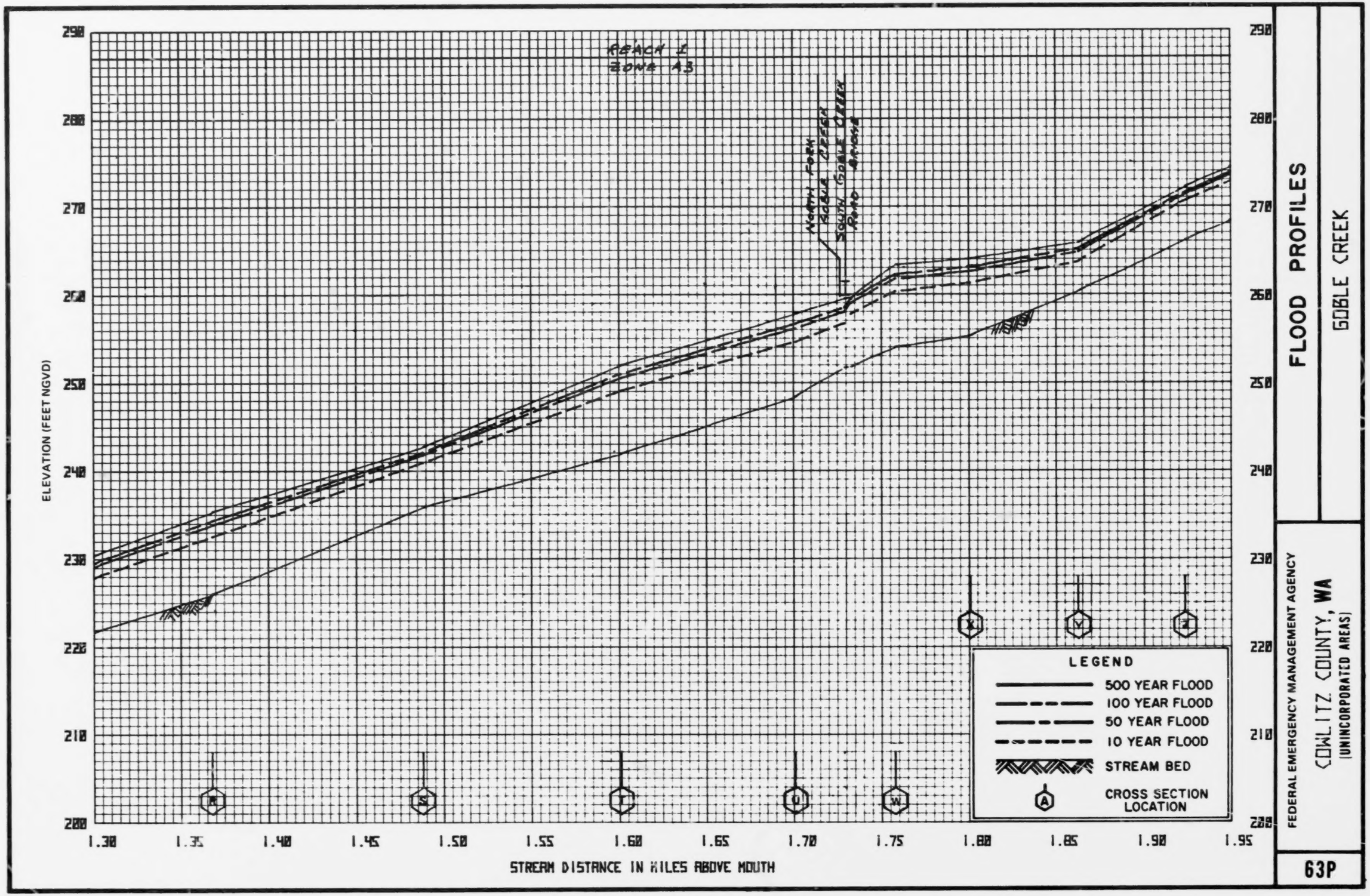
FLOOD PROFILES

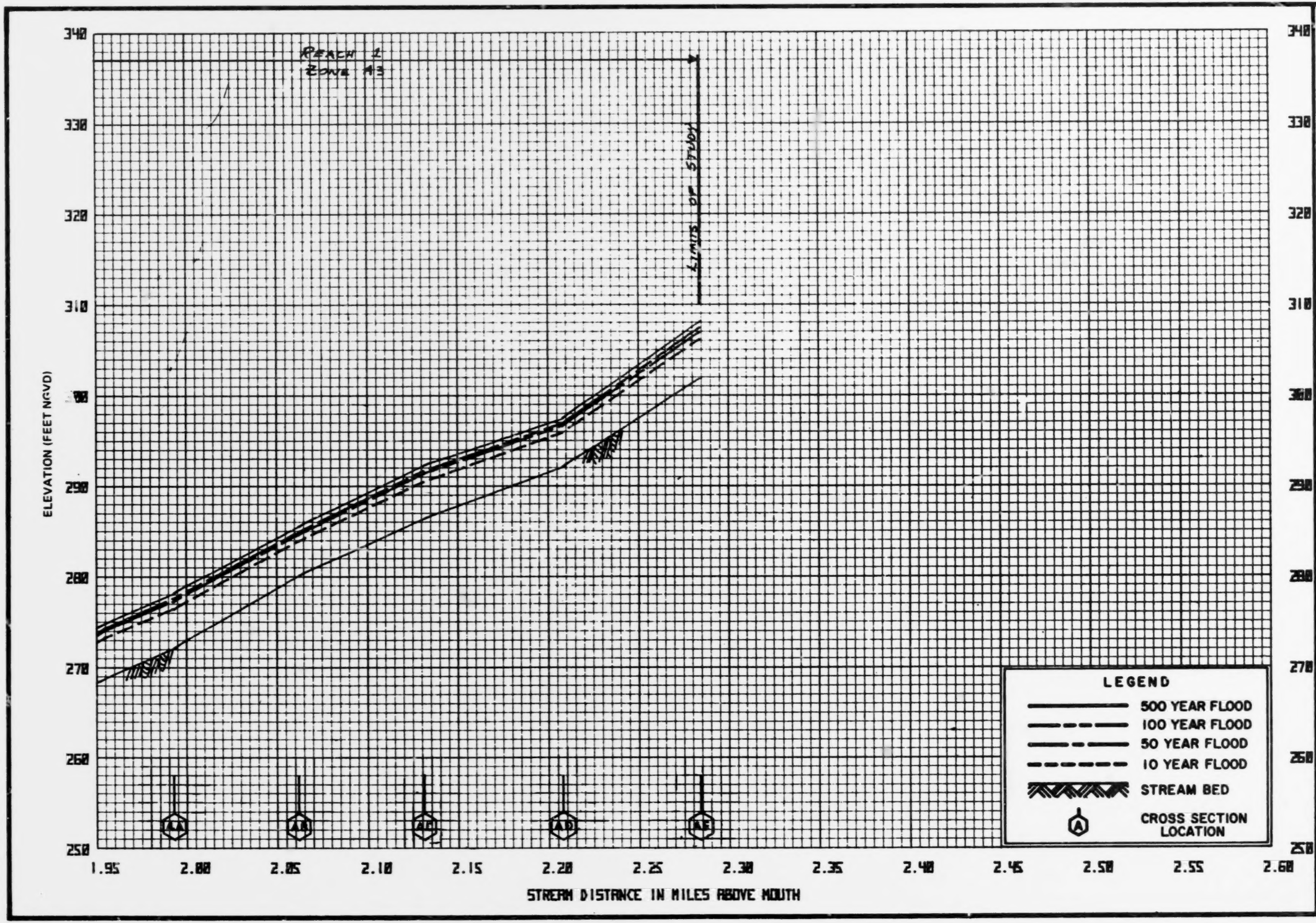
GOBLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

62P


REACH 2
ZONE AE
NORTH FORK
GOBLE CREEK
SOUTH GOBLE CREEK
ROAD ABOVE
ELEVATION (FEET NGVD)
290
280
270
260
250
240
230
220
210
200
1.30
1.35
1.40
1.45
1.50
1.55
1.60
1.65
1.70
1.75
1.80
1.85
1.90
1.95
STREAM DISTANCE IN MILES ABOVE MOUTH
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
A
FLOOD PROFILES
GOBLE CREEK
FEDERAL EMERGENCY MANAGEMENT AGENCY
COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)
63P



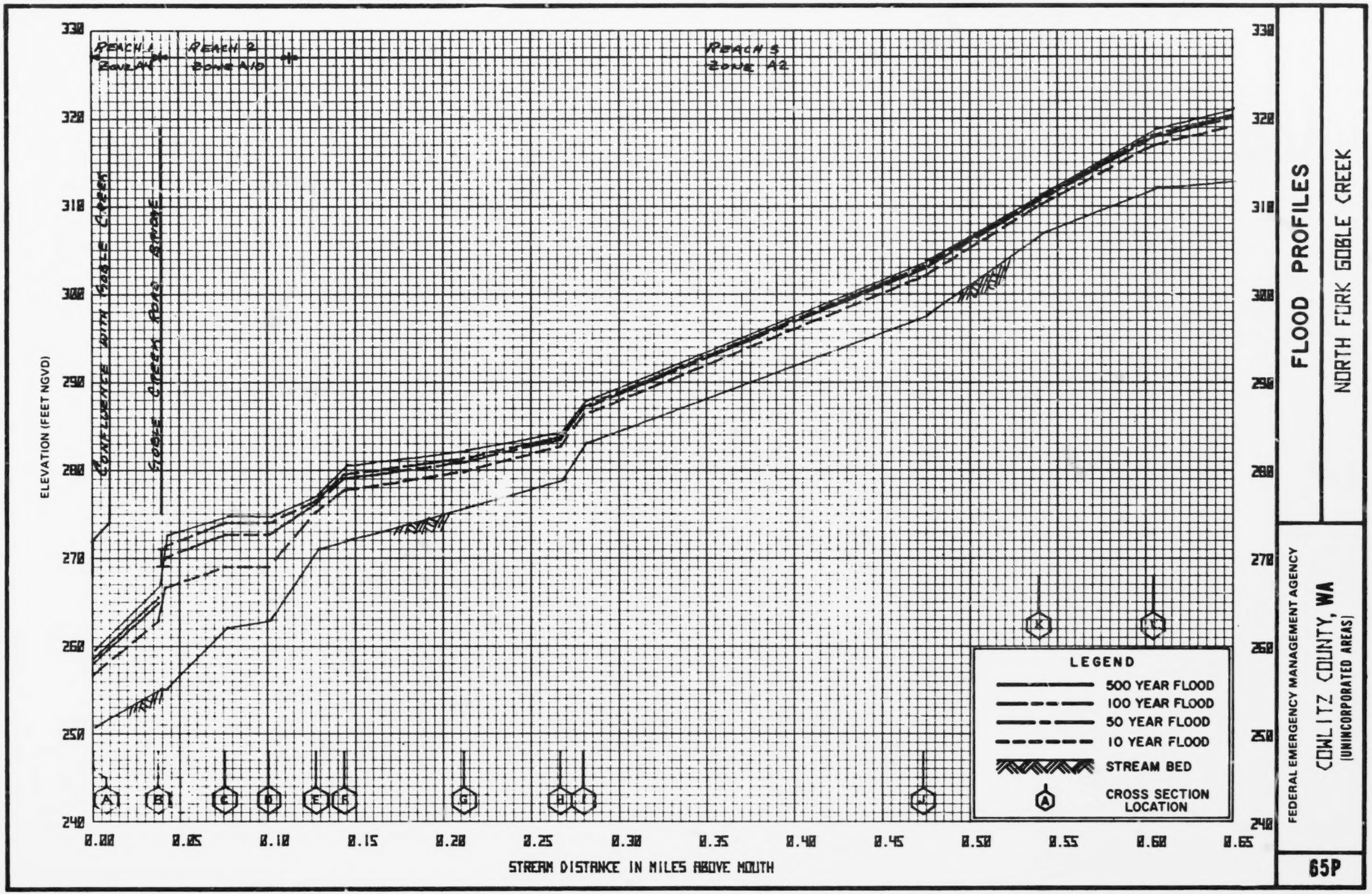
FLOOD PROFILES

GOBLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

64P



FLOOD PROFILES

NORTH FORK GOBLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINCORPORATED AREAS)

65P

118

REACH 3
ZONE A2

ARGENTA BRIDGE

ELEVATION (FEET NGVD)

390
380
370
360
350
340
330
320
310
300

0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00 1.05 1.10 1.15 1.20 1.25 1.30

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

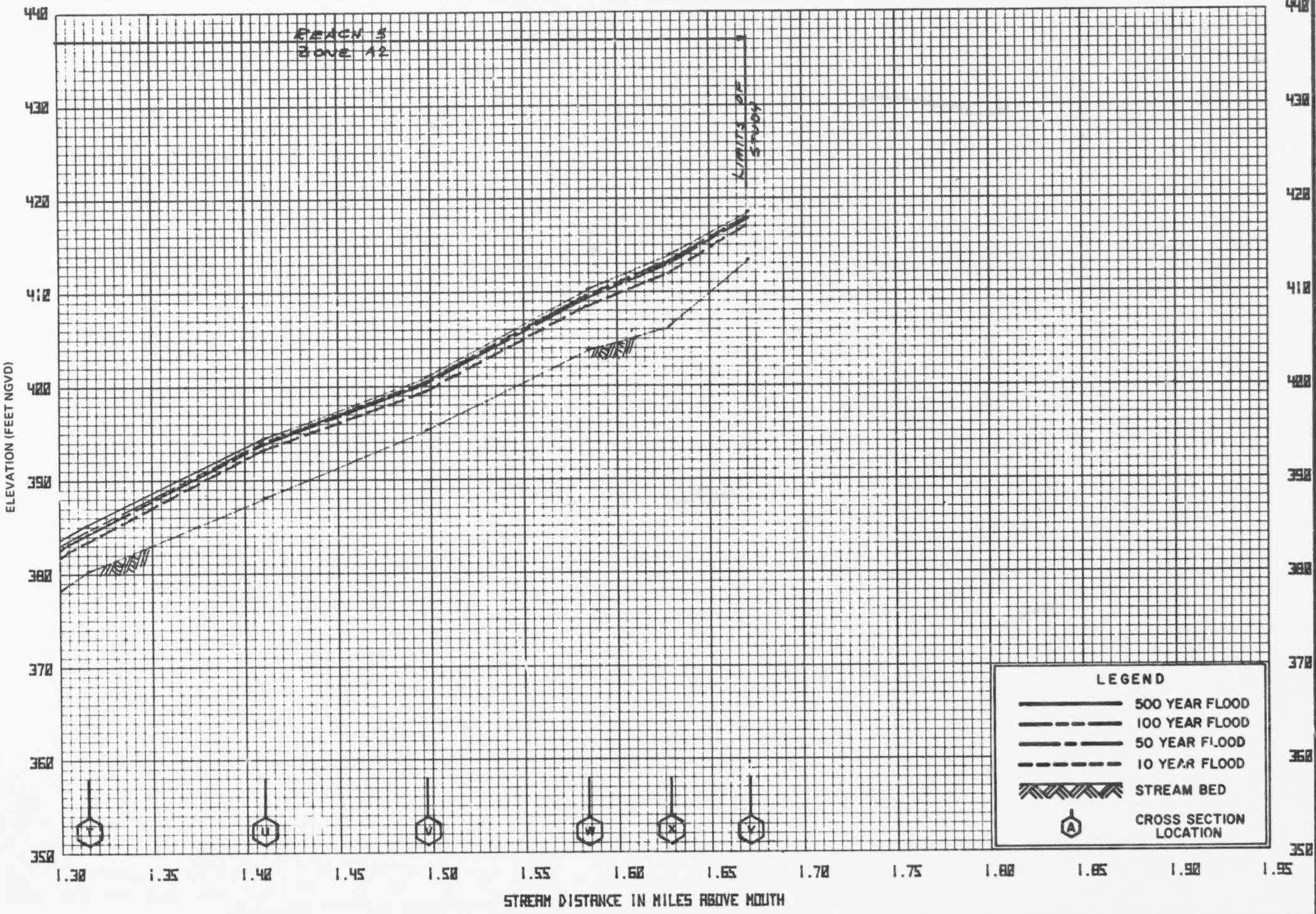
FLOOD PROFILES

NORTH FORK GOBLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

66P



FLOOD PROFILES

NORTH FORK GOBLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINCORPORATED AREAS)

67P

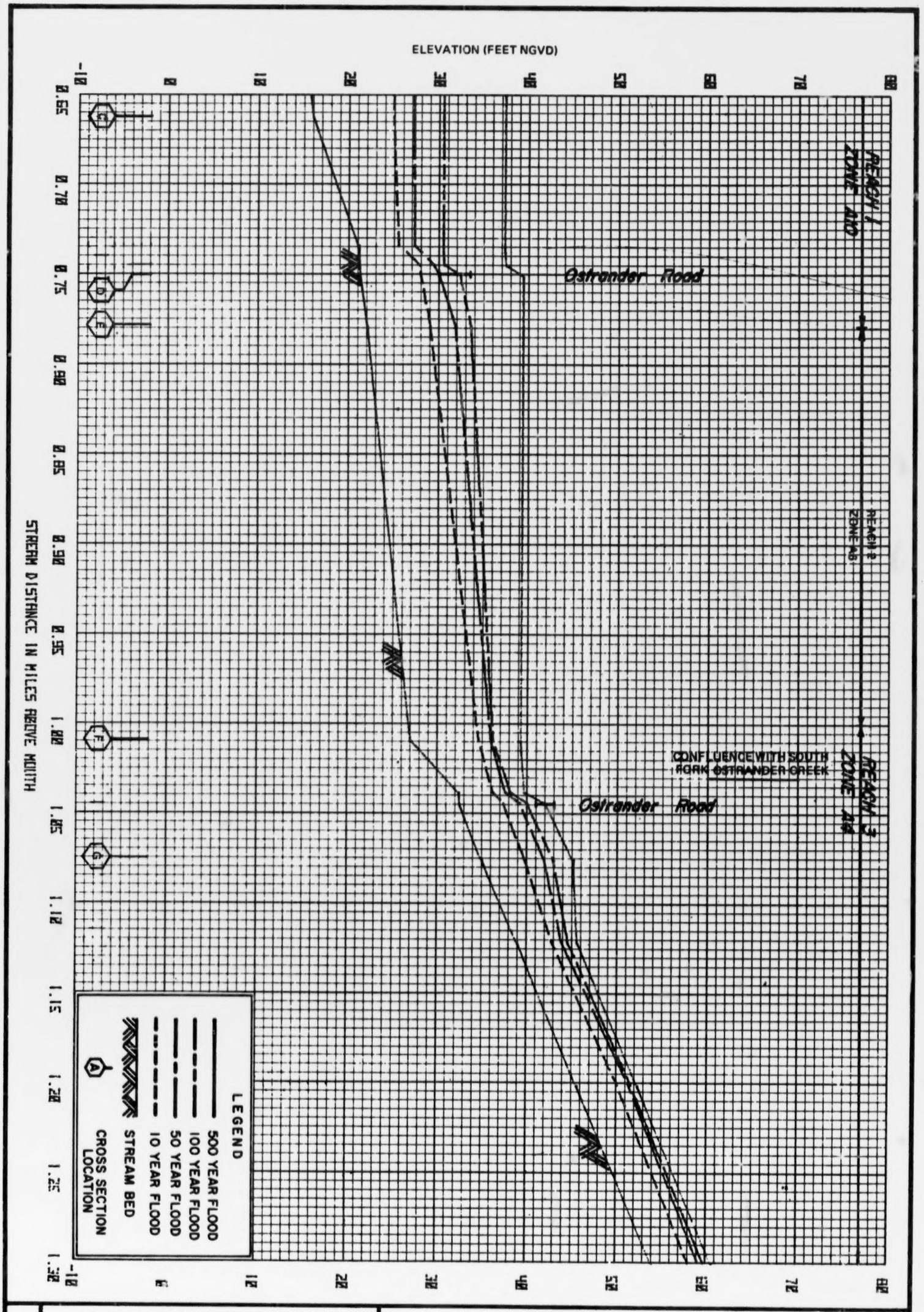
FLOOD PROFILES

OSTRANDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

68P



FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

OSTRANDER CREEK

69P

REACH 3

ZONE AH

ELEVATION (FEET NGVD)

140
130
120
110
100
90
80
70
60
50

1.30 1.35 1.40 1.45 1.50 1.55 1.60 1.65 1.70 1.75 1.80 1.85 1.90 1.95

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

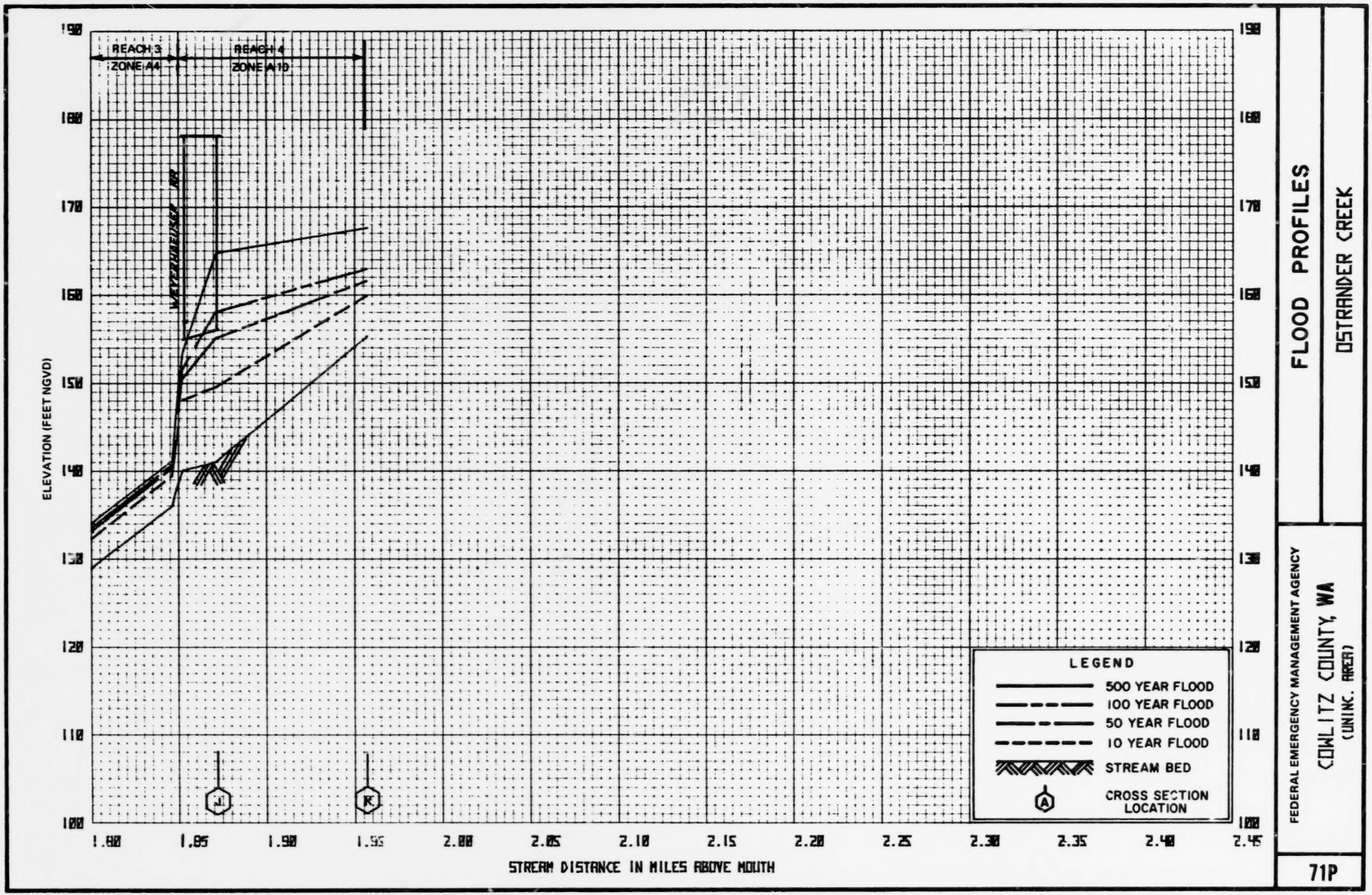
FLOOD PROFILES

OSTRANDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

70P



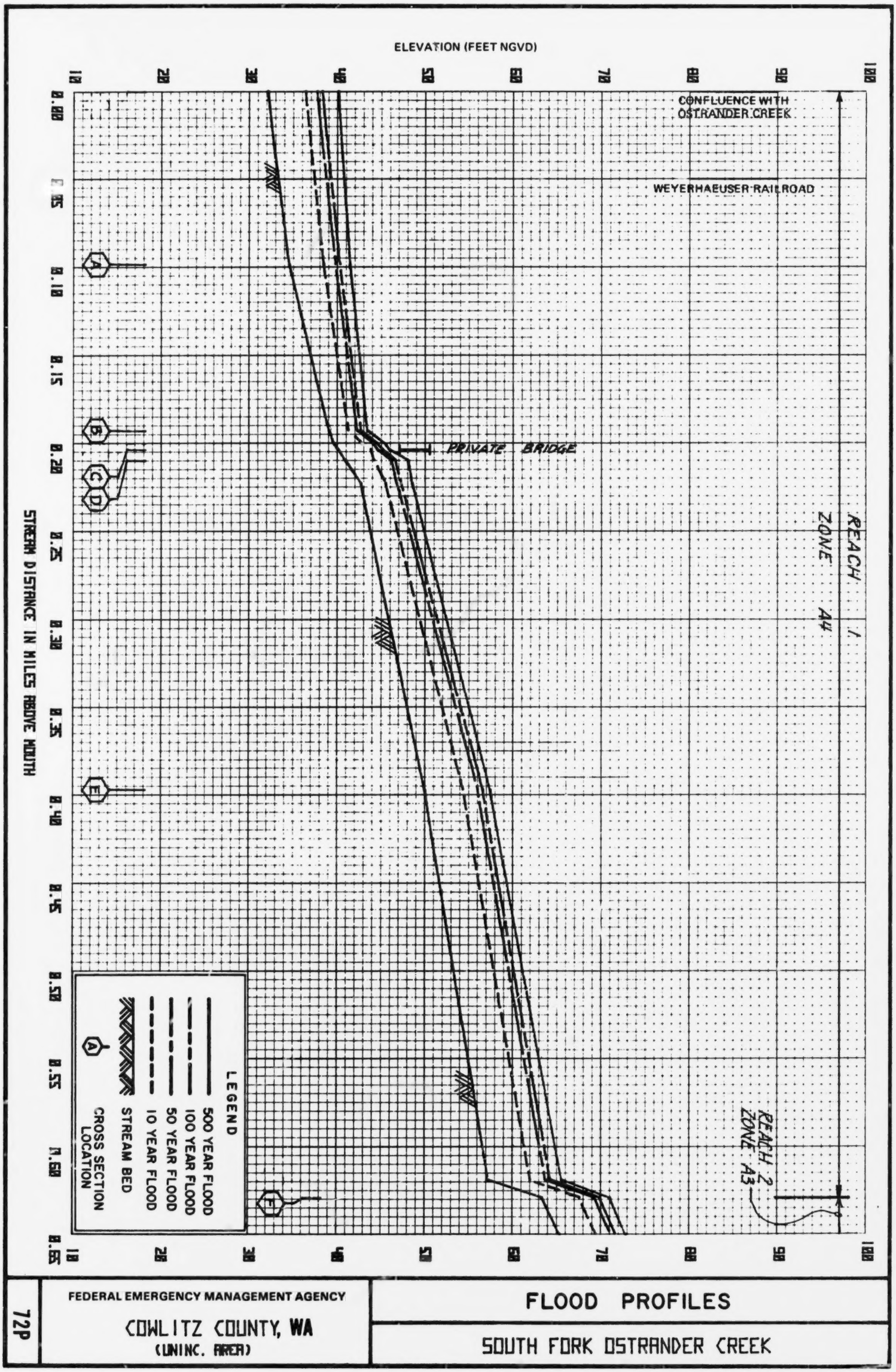
FLOOD PROFILES

OSTRANDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

71P



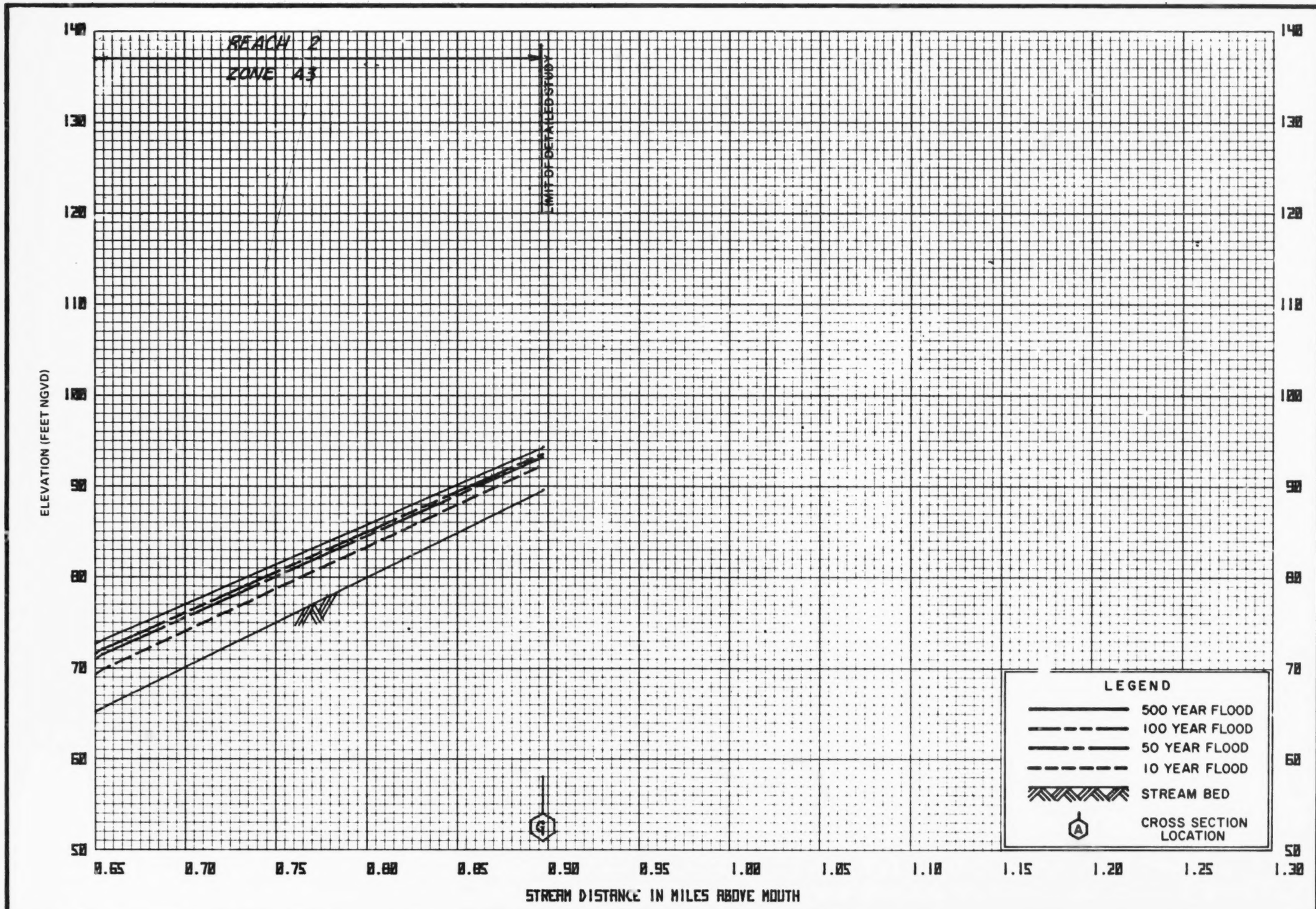
72P

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

FLOOD PROFILES

SOUTH FORK OSTRANDER CREEK



FLOOD PROFILES

SOUTH FORK OSTRANDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

73P

FLOOD PROFILES

ARKANSAS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

74P

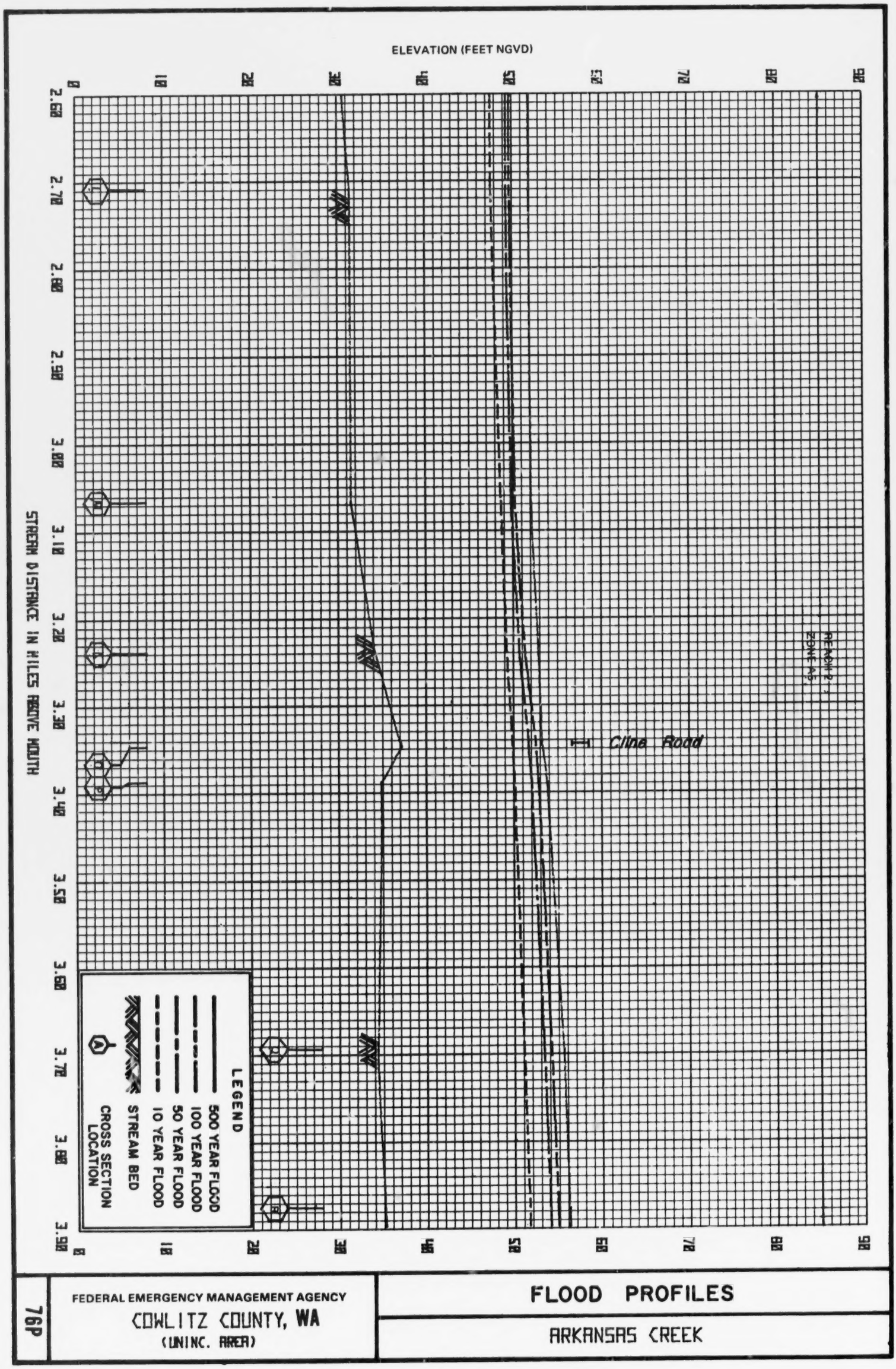
FLOOD PROFILES

ARKANSAS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

75P



FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

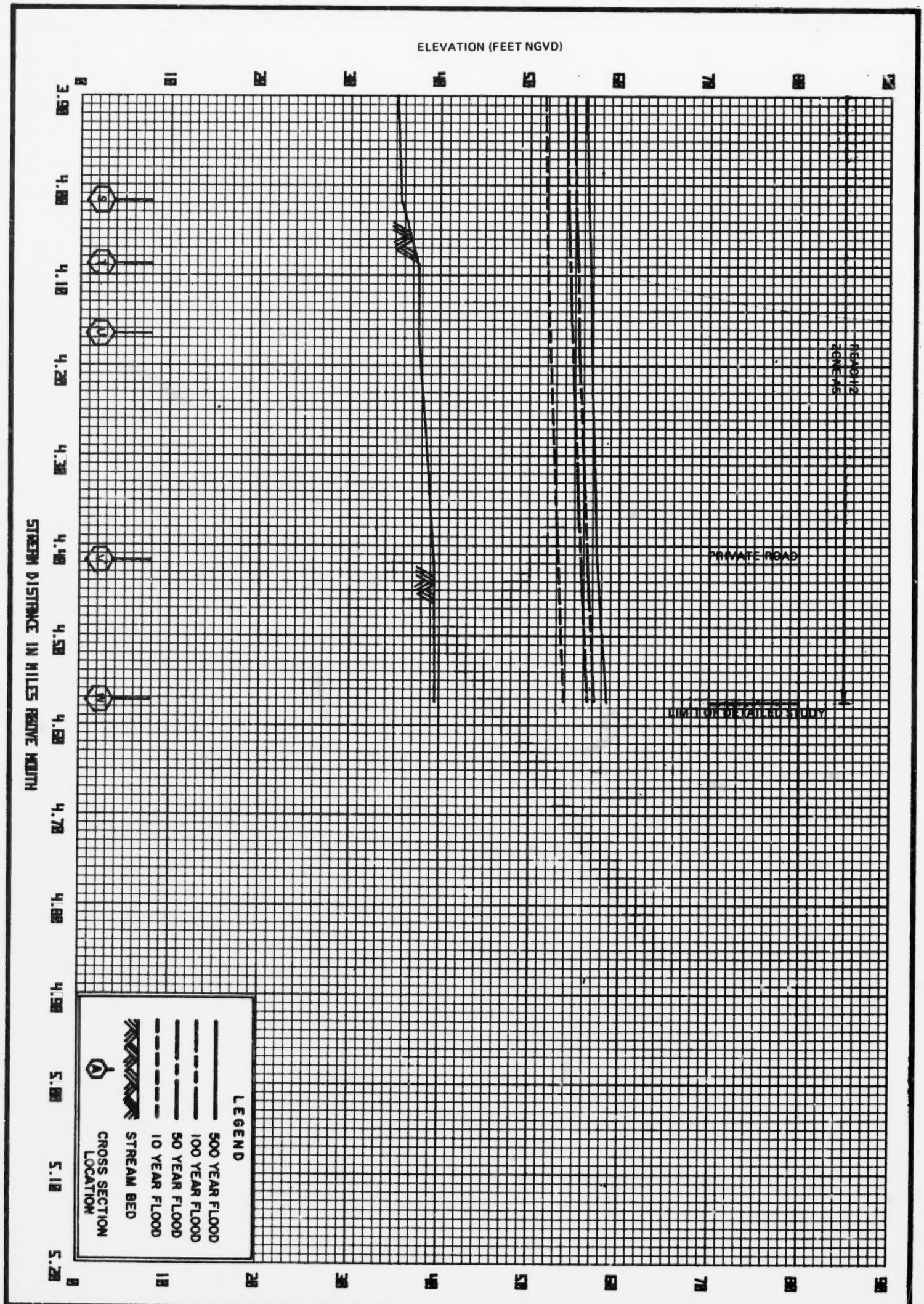
(UNINC. AREA)

FLOOD PROFILES

ARKANSAS CREEK

76P

129



77P

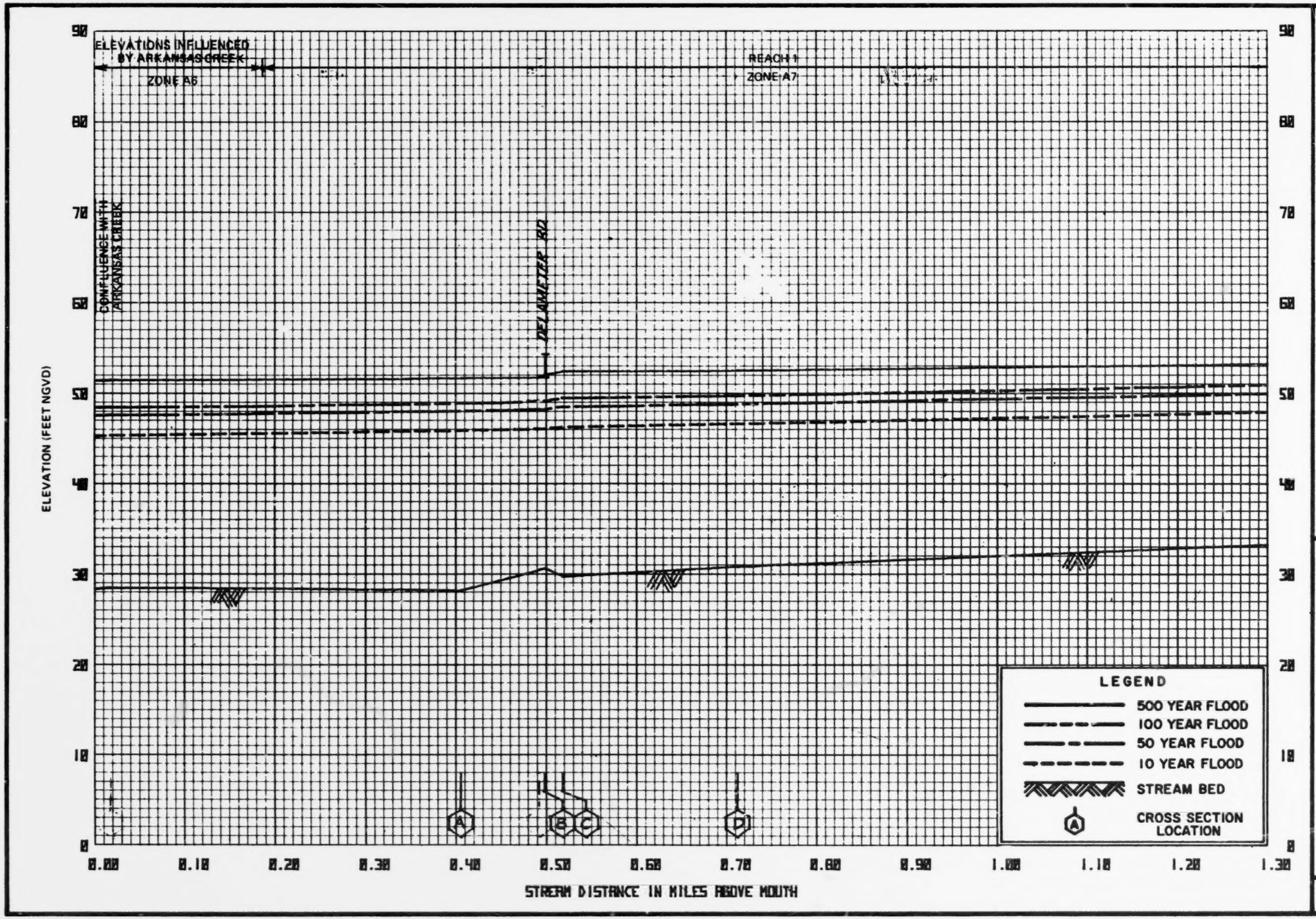
FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

FLOOD PROFILES

ARKANSAS CREEK

130



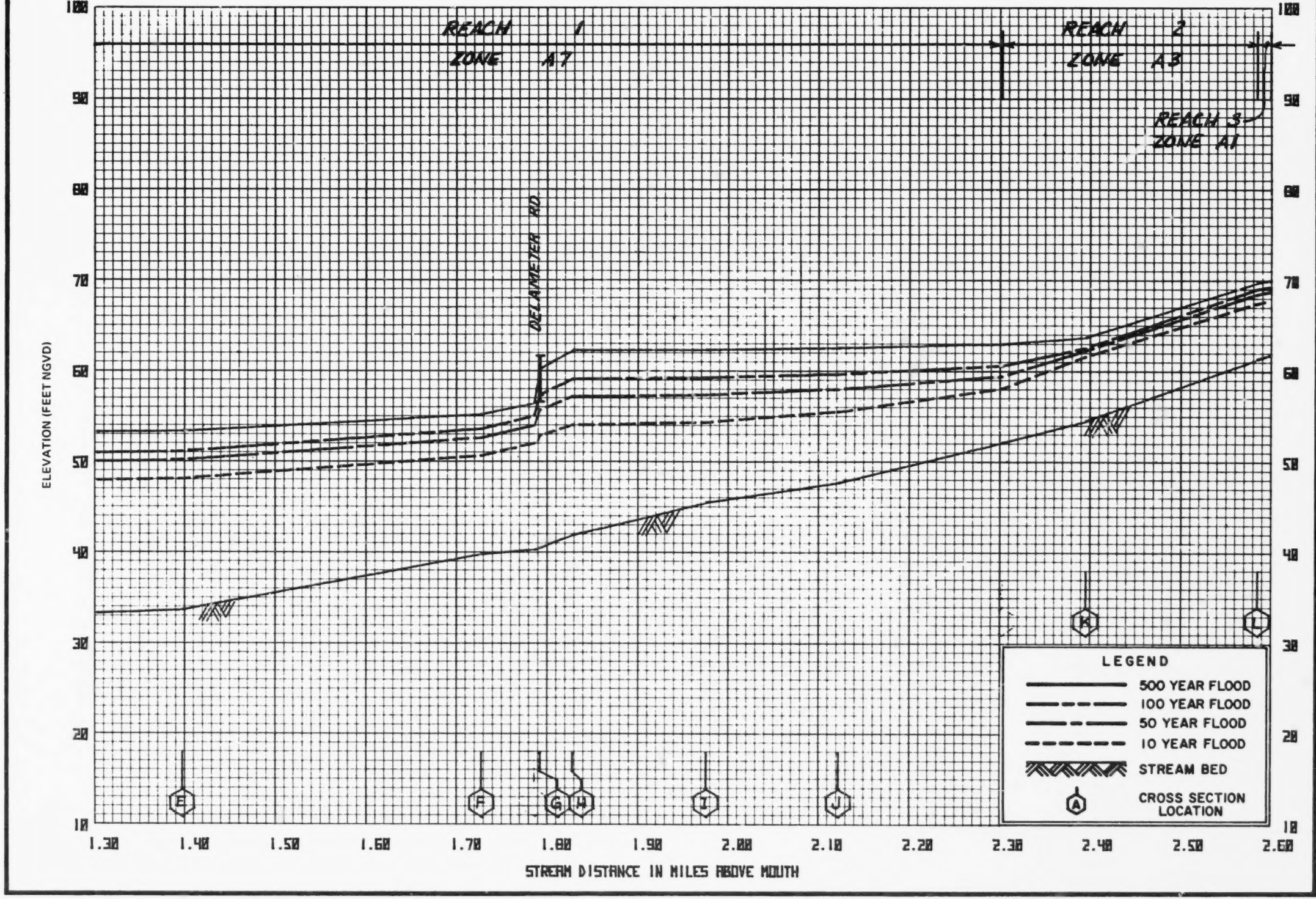
FLOOD PROFILES

DELAMETER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

78P



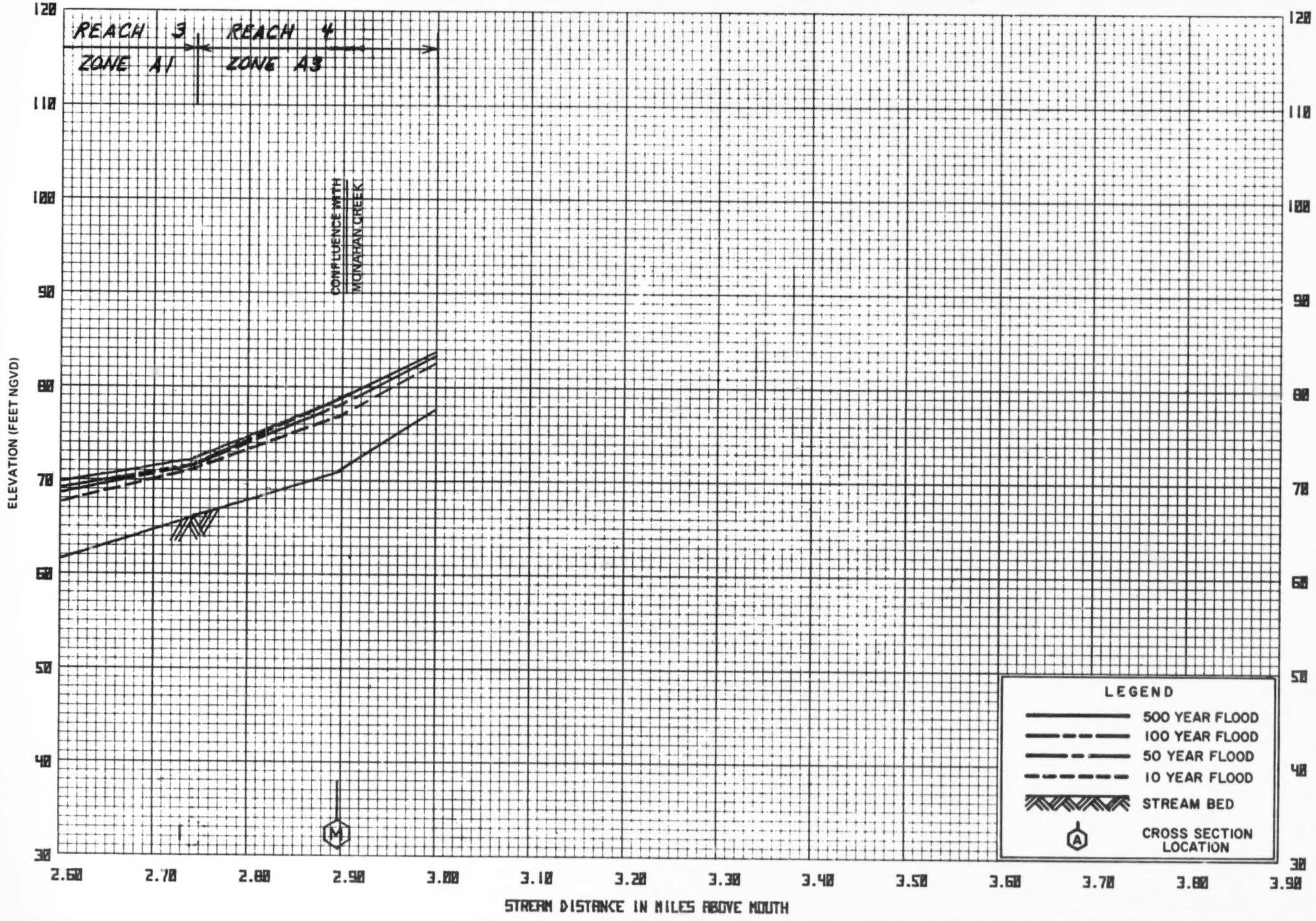
FLOOD PROFILES

DELAMETER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

79P



FLOOD PROFILES

DELAMETER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA.
(UNINC. AREA)

80P

REACH 1
ZONE A3

CONFLUENCE WITH DELANEY CREEK

ELEVATION (FEET NGVD)

130
120
110
100
90
80
70
60
50
40

0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00 1.10 1.20 1.30

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND
- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- (A) CROSS SECTION LOCATION

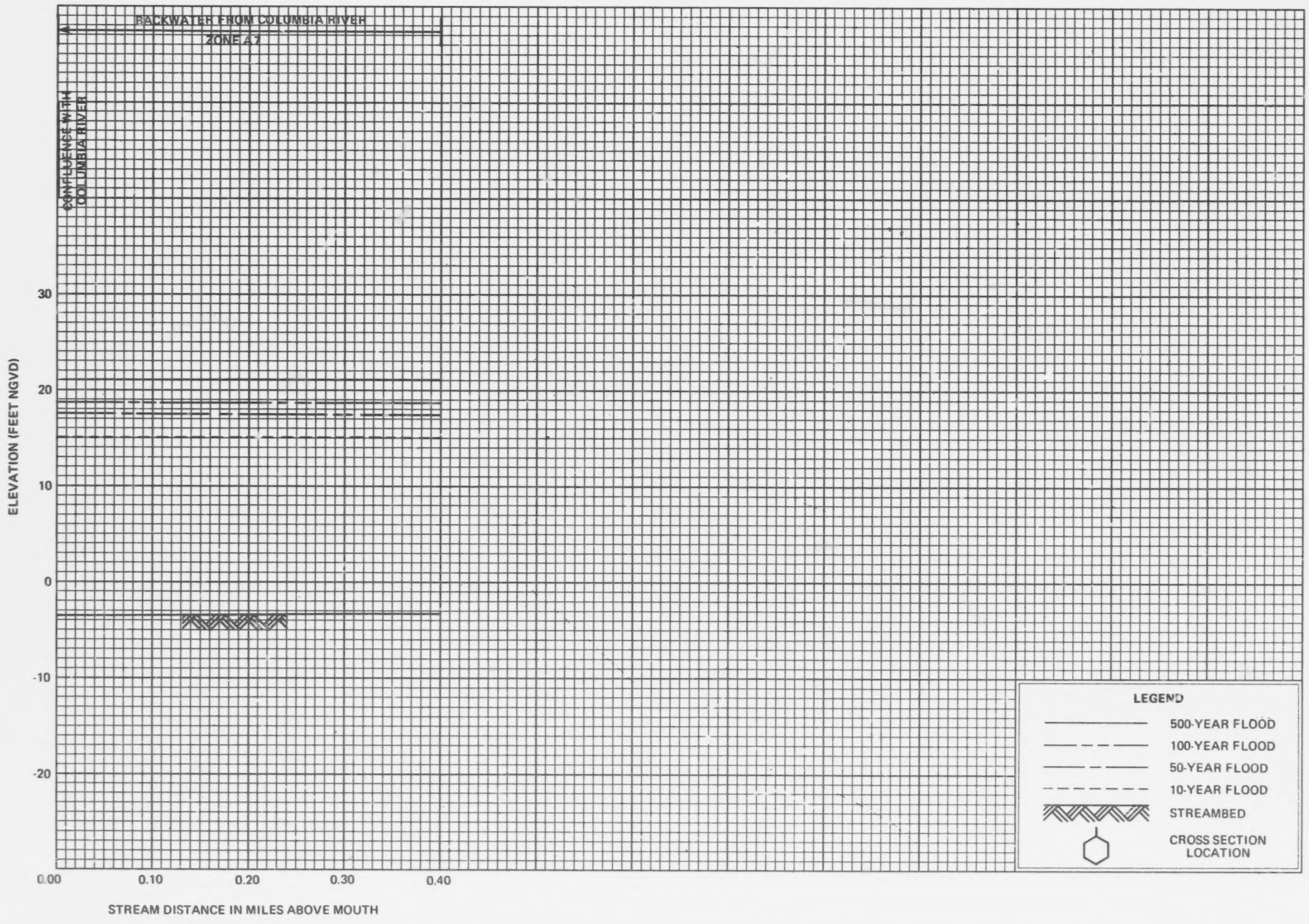
FLOOD PROFILES

MONAHAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

81P



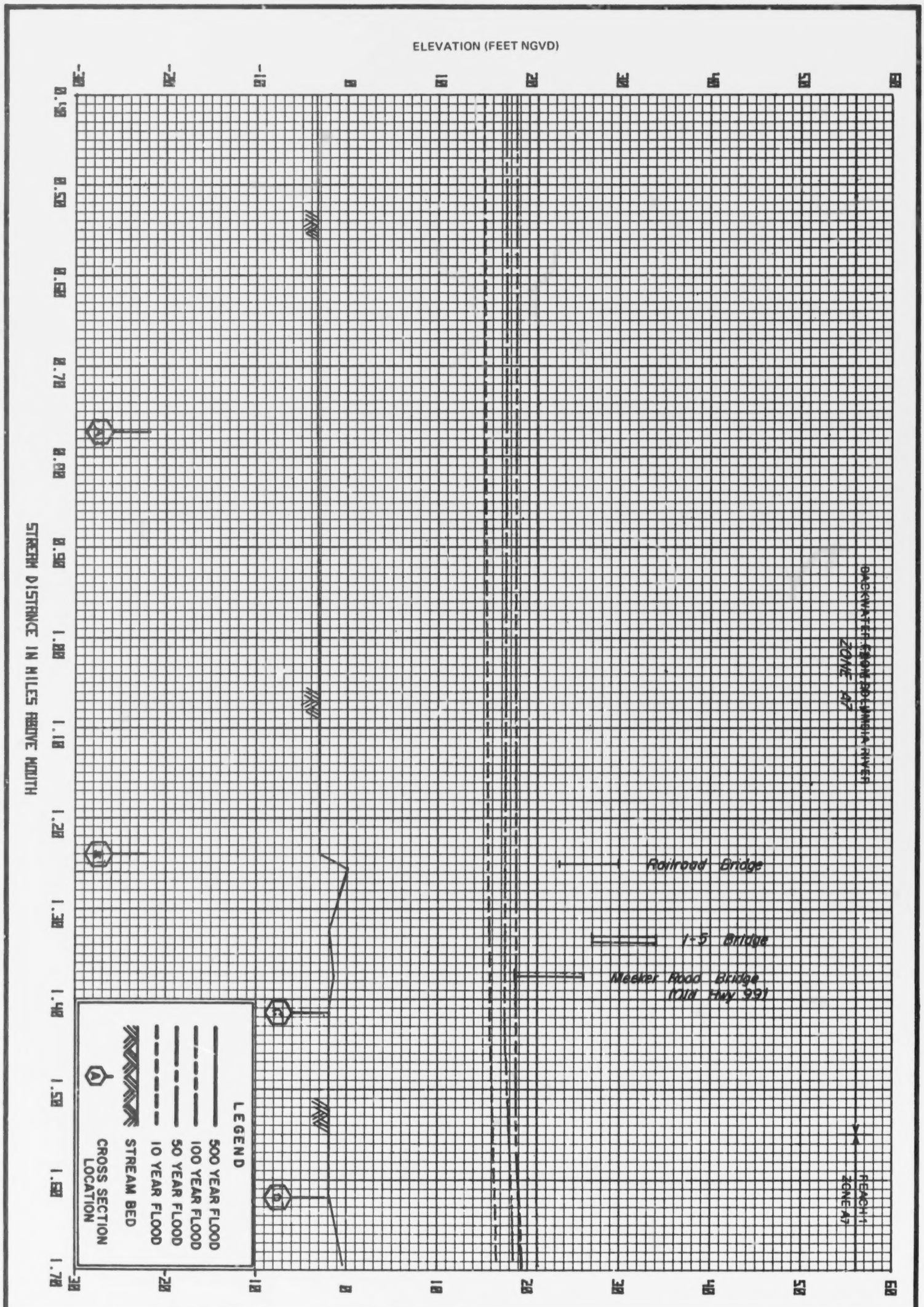
FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

82P



136

83P

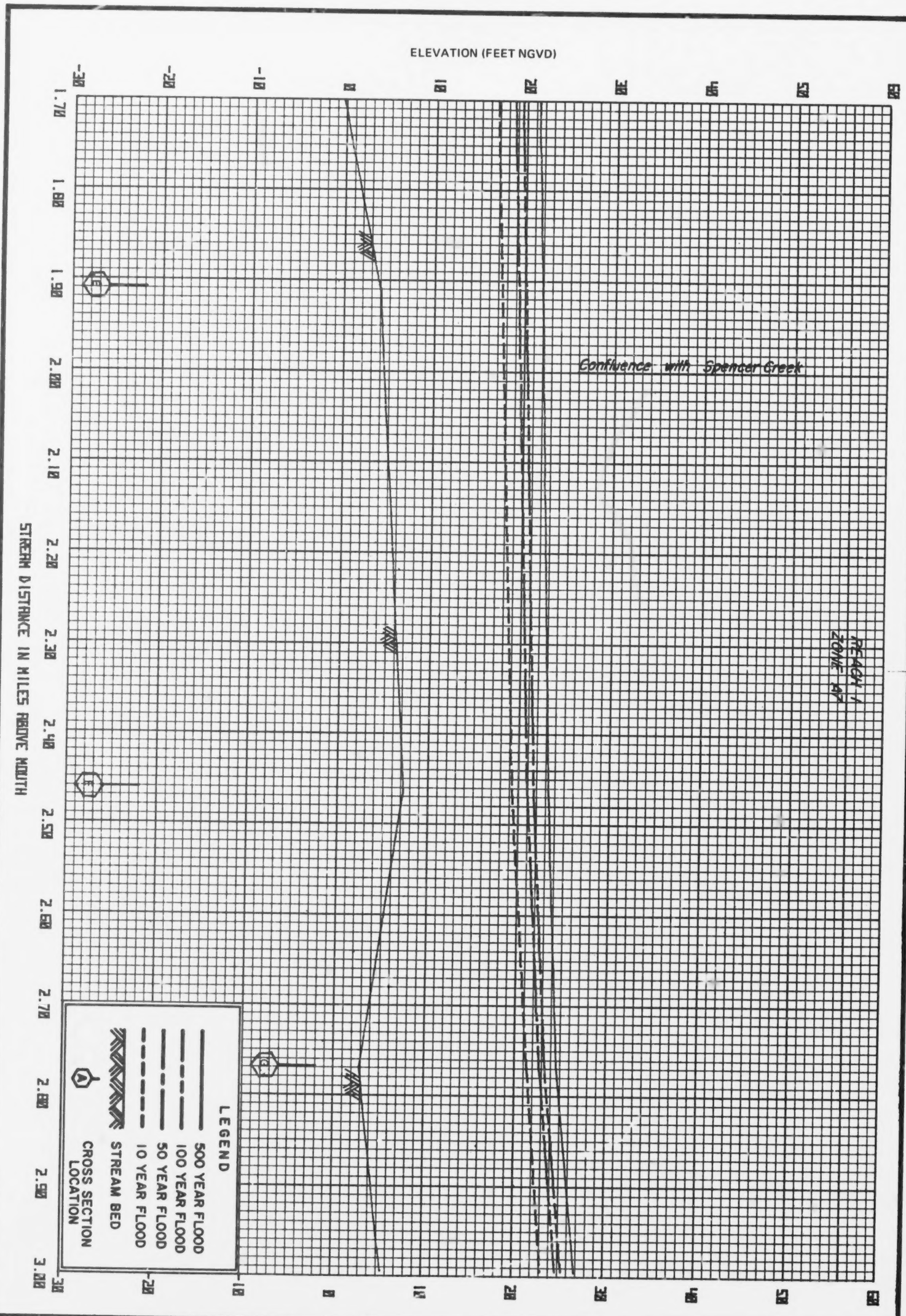
FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINC. AREA)

FLOOD PROFILES

KALAMA RIVER



84P

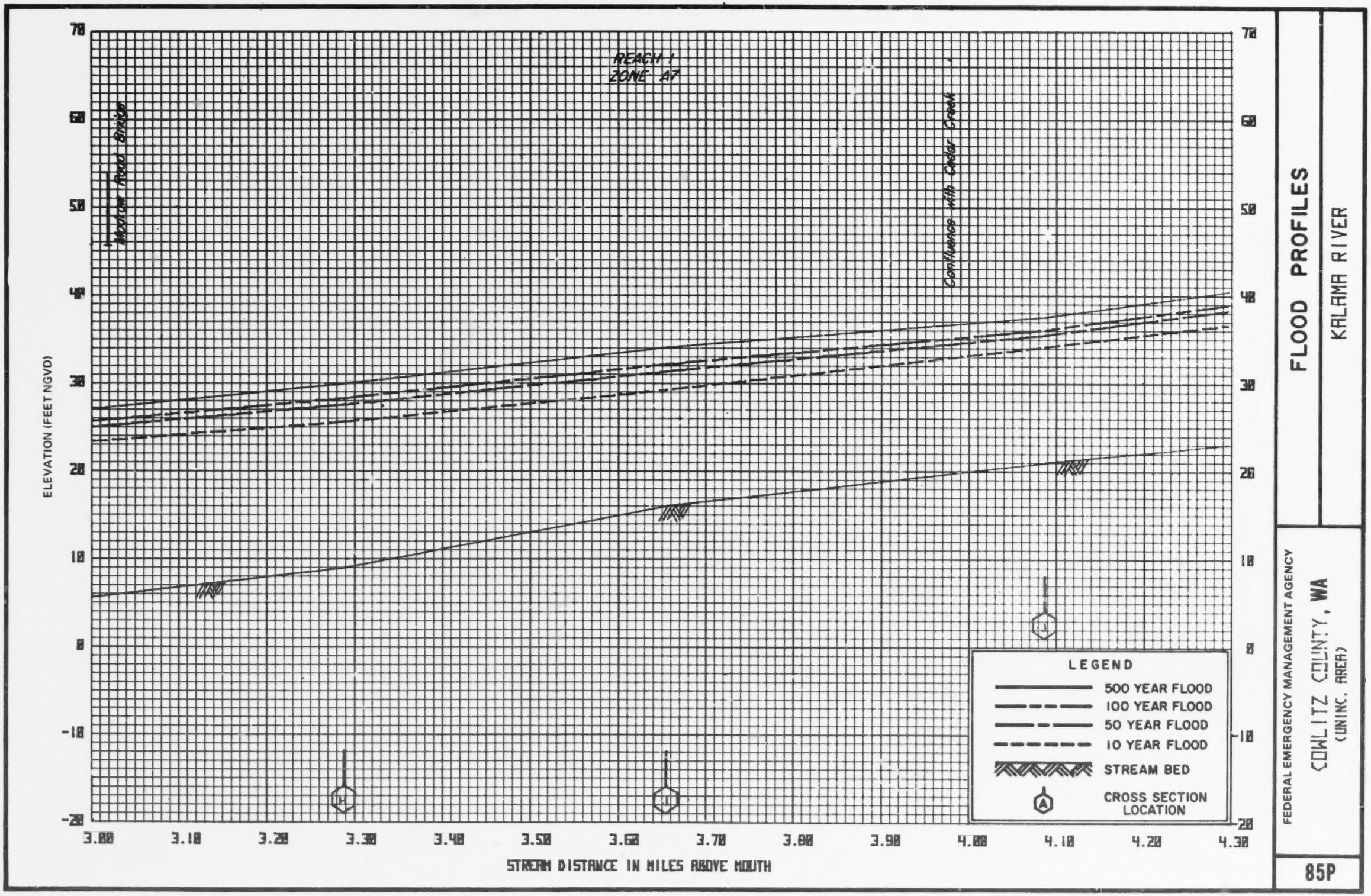
FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

FLOOD PROFILES

KALAMA RIVER

137



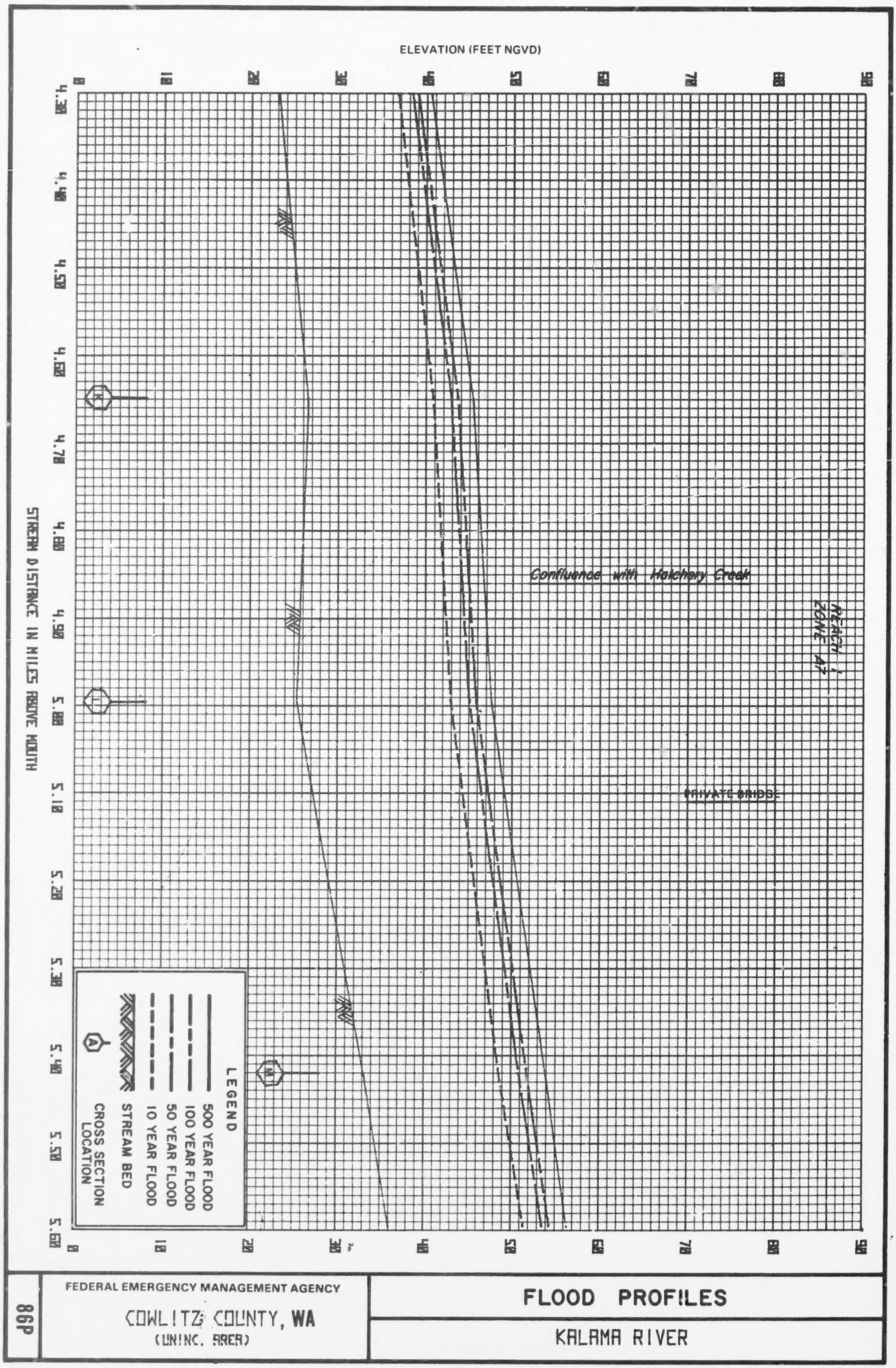
FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

85P



FEDERAL EMERGENCY MANAGEMENT AGENCY

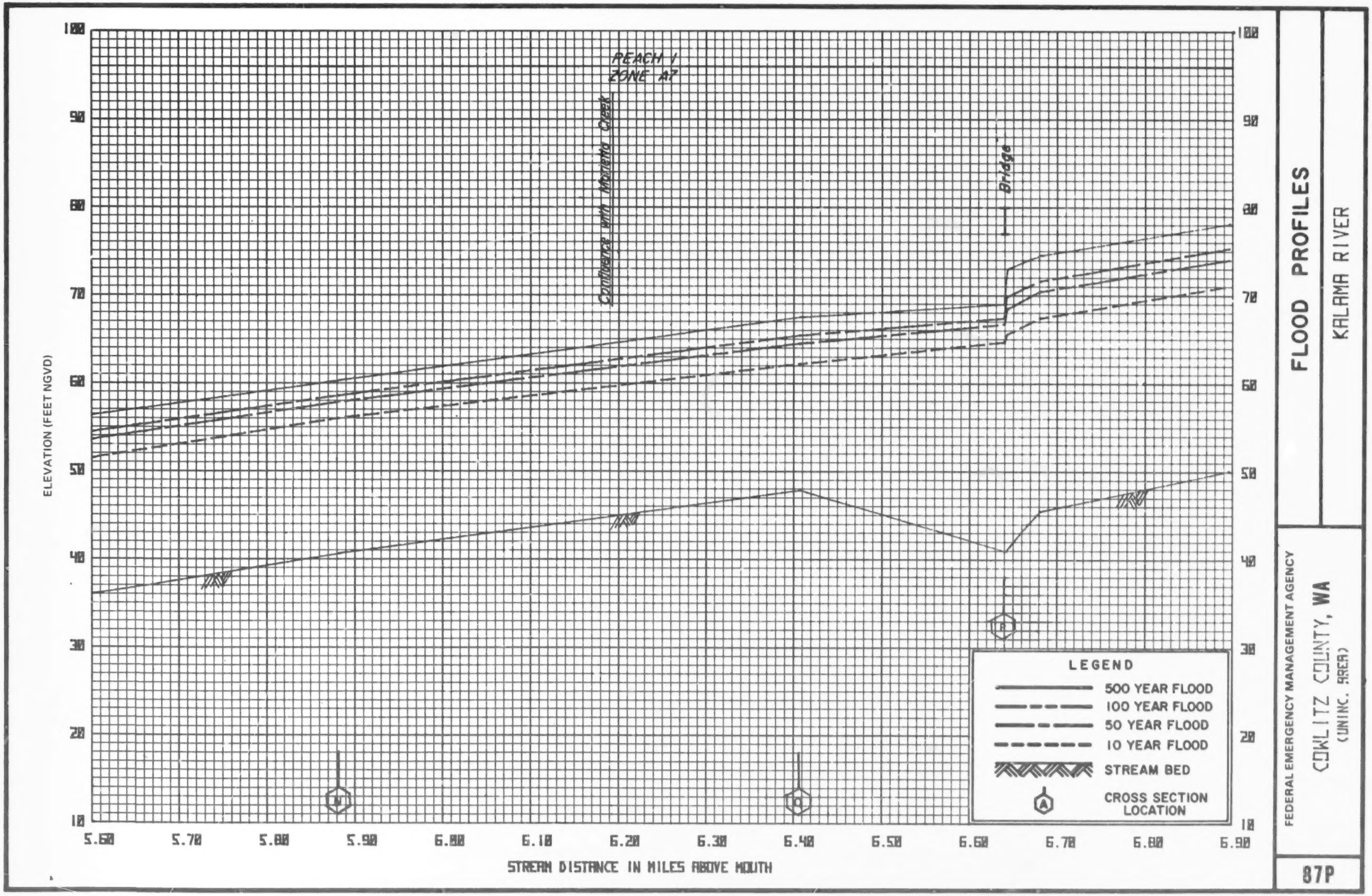
COWLITZ COUNTY, WA
(UNINC. AREA)

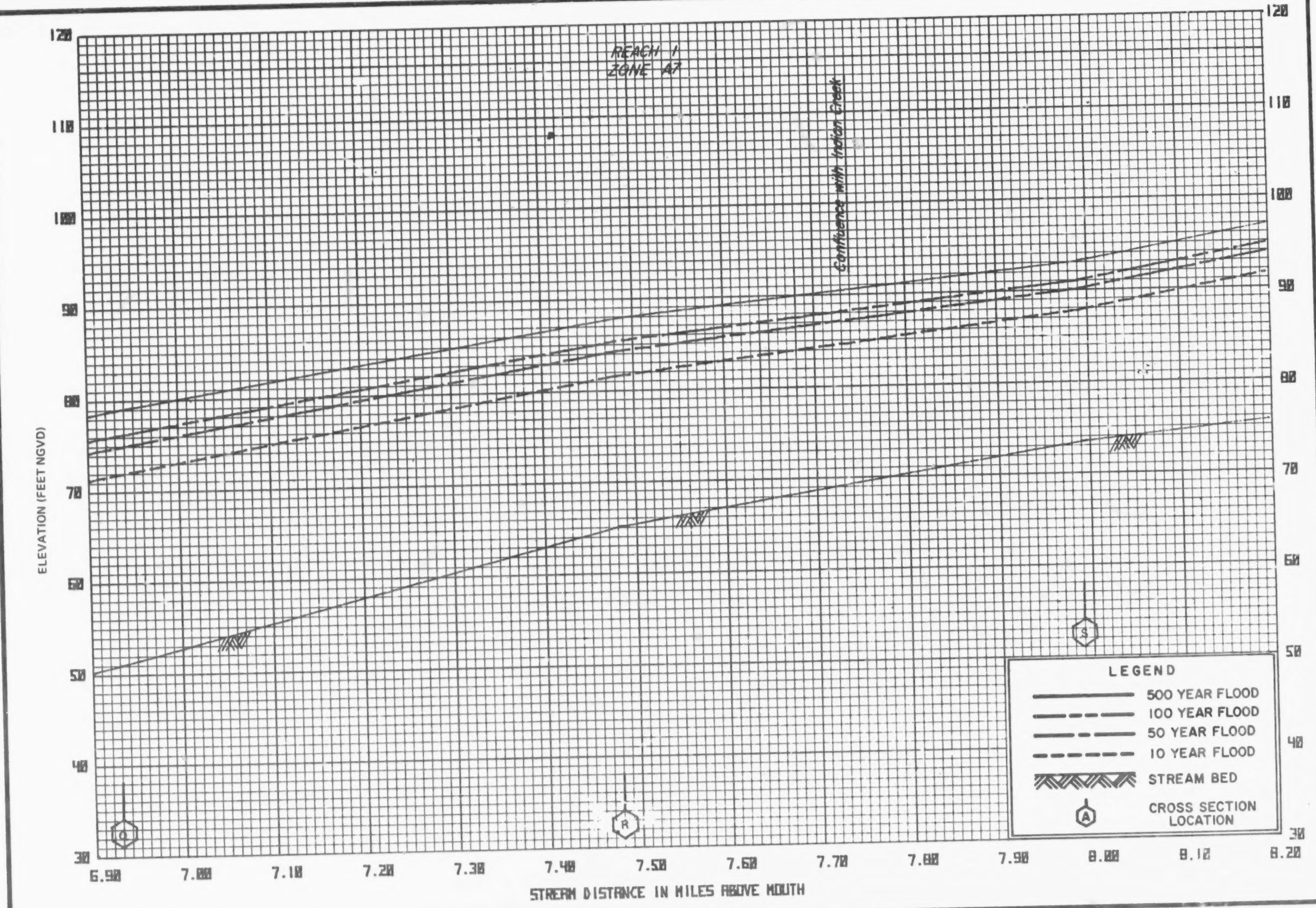
FLOOD PROFILES

KALAMA RIVER

86P

139


REACH J
ZONE AE
CONFLUENCE WITH MORENO CREEK
Bridge
ELEVATION (FEET NGVD)
100
90
80
70
60
50
40
30
20
10
5.60
5.70
5.80
5.90
6.00
6.10
6.20
6.30
6.40
6.50
6.60
6.70
6.80
6.90
STREAM DISTANCE IN MILES ABOVE MOUTH
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
A
V
FLOOD PROFILES
KALAMA RIVER
FEDERAL EMERGENCY MANAGEMENT AGENCY
COWLITZ COUNTY, WA
(UNINC. AREA)
87P



FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

88P

REACH 1
ZONE A7

RELIVATED BRIDGE

Confluence with Woodard Creek

ELEVATION (FEET NGVD)

150
140
130
120
110
100
90
80
70
60

8.20 8.30 8.40 8.50 8.60 8.70 8.80 8.90 9.00 9.10 9.20 9.30 9.40 9.50

STREAM DISTANCE IN MILES ABOVE MOUTH

T
U
V

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

89P

REACH 1
ZONE A7

ELEVATION (FEET NGVD)

200
190
180
170
160
150
140
130
120
110

9.50 9.60 9.70 9.80 9.90 10.00 10.10 10.20 10.30 10.40 10.50 10.60 10.70 10.80

STREAM DISTANCE IN MILES ABOVE MOUTH

200 230
90 220
210
70 200
60
190
50 180
40
170
30 160
20 150
110 140

W X Y X AA

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

90P

REACH 1
ZONE A7

ELEVATION (FEET NGVD)

290
280
270
260
250
240
230
220
210
200

10.80 10.90 11.00 11.10 11.20 11.30 11.40 11.50 11.60 11.70 11.80 11.90 12.00 12.10

STREAM DISTANCE IN MILES ABOVE MOUTH

AB AC AD AE

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- (A) CROSS SECTION LOCATION

FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

91P

REACH 1
ZONE A7

ELEVATION (FEET NGVD)

290
280
270
260
250
240
230
220
210
200

12.10 12.20 12.30 12.40 12.50 12.60 12.70 12.80 12.90 13.00 13.10 13.20 13.30 13.40

STREAM DISTANCE IN MILES ABOVE MOUTH

AF AG AH AI

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- (A) CROSS SECTION LOCATION

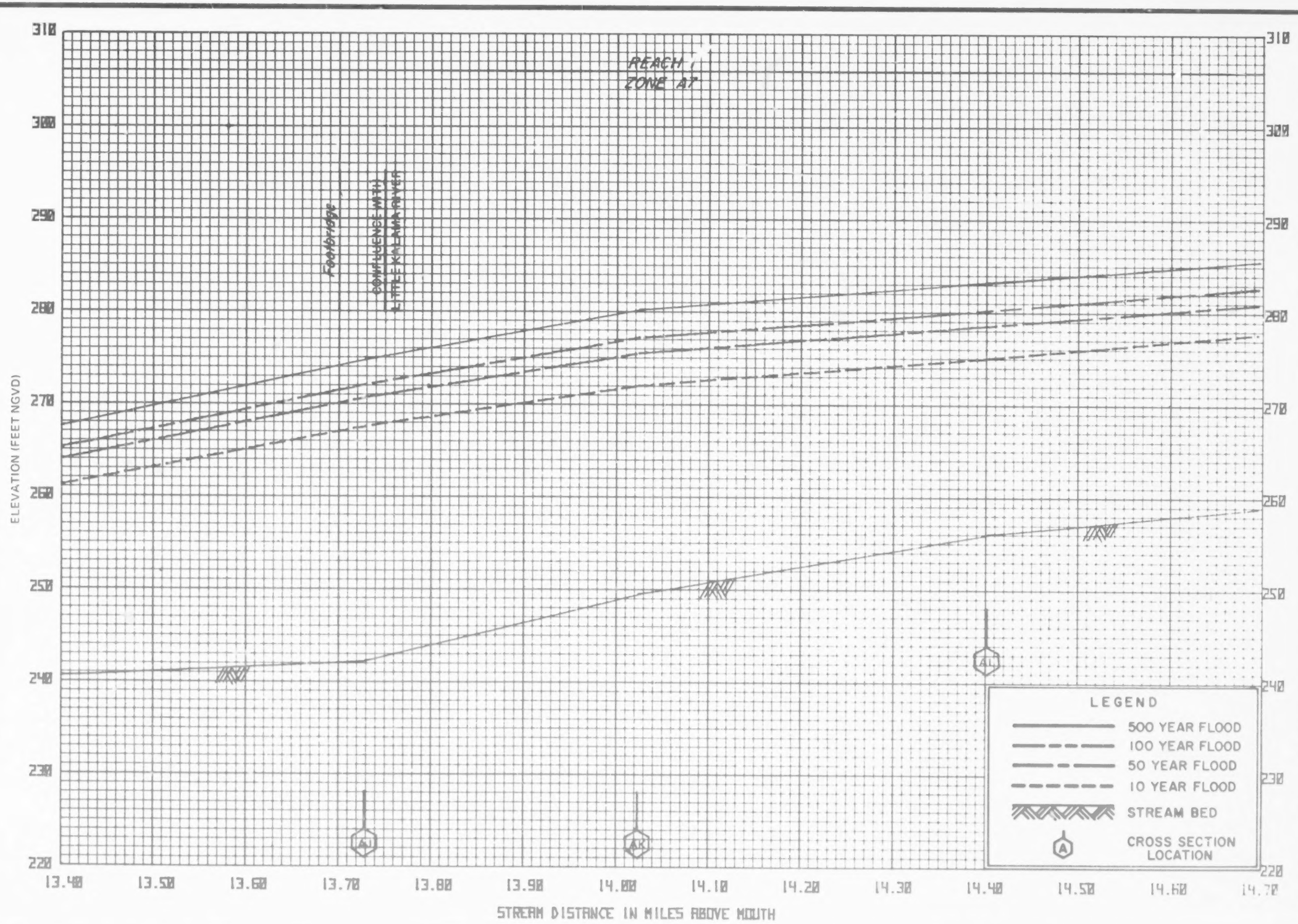
FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

92P



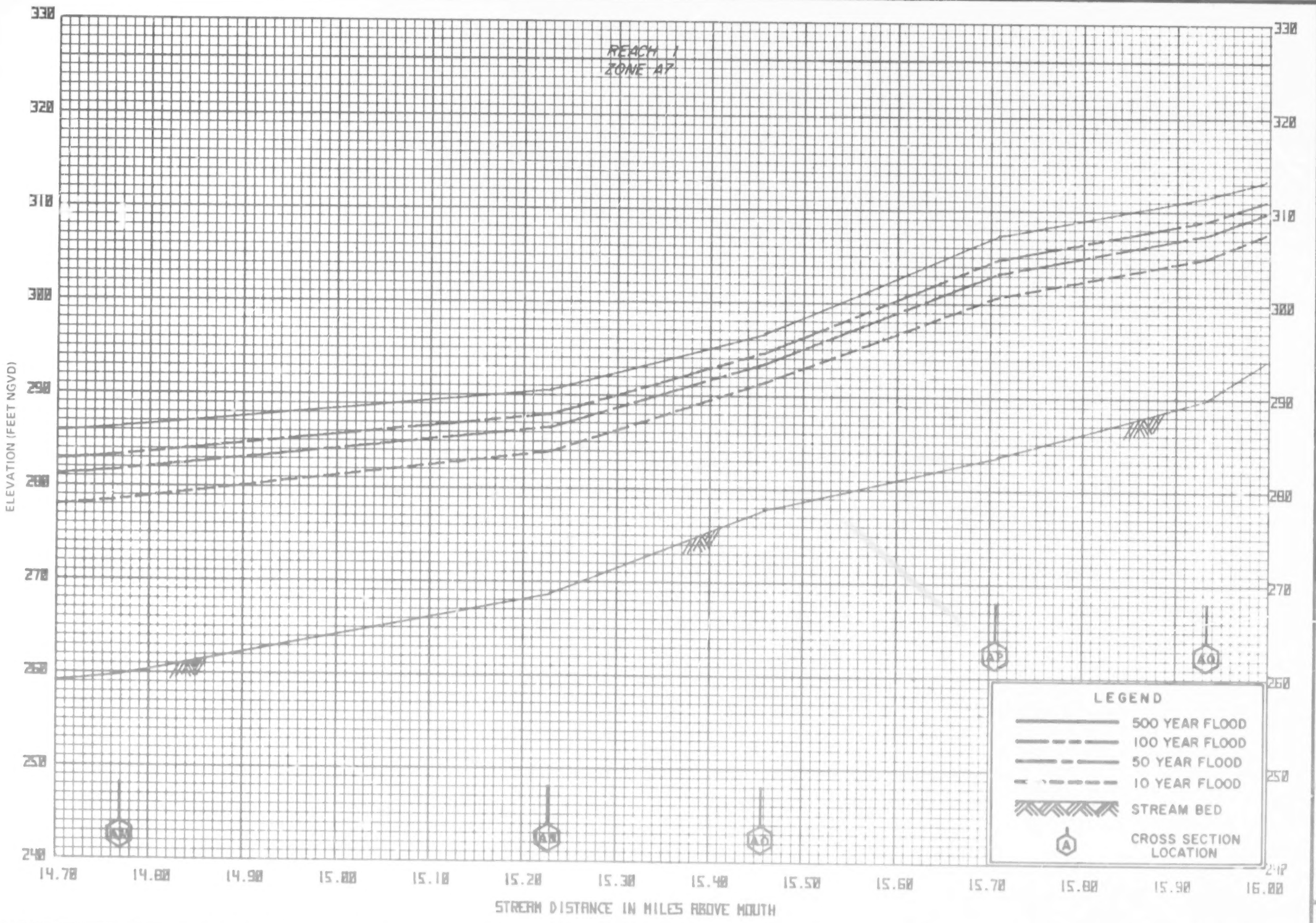
FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

93P



FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINC. AREA)

94P

REACH 1
ZONE A7

ELEVATION (FEET NGVD)

370
360
350
340
330
320
310
300
290
280

16.00 16.10 16.20 16.30 16.40 16.50 16.60 16.70 16.80 16.90 17.00 17.10 17.20 17.30

STREAM DISTANCE IN MILES ABOVE MOUTH

AR AS AT AU AV AW AX AY

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- (A) CROSS SECTION LOCATION

FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA

(UNINC. AREA)

95P

REACH I
ZONE A7
Footbridge
ELEVATION (FEET NGVD)
420
410
400
390
380
370
360
350
340
330
17.30
17.40
17.50
17.60
17.70
17.80
17.90
18.00
18.10
18.20
18.30
18.40
18.50
18.60
STREAM DISTANCE IN MILES ABOVE MOUTH
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
A
FLOOD PROFILES
KALAMA RIVER
FEDERAL EMERGENCY MANAGEMENT AGENCY
COWLITZ COUNTY, WA
(UNINC. AREA)
96P

REACH 1
ZONE A7

Footbridge

LIMIT OF DETAILED STUDY

ELEVATION (FEET NGVD)

450
440
430
420
410
400
390
380
370
360

18.60 18.70 18.80 18.90 19.00 19.10 19.20 19.30 19.40 19.50 19.60 19.70 19.80 19.90

STREAM DISTANCE IN MILES ABOVE MOUTH

BD BE BF BG BH

LEGEND

- 500 YEAR FLOOD
- 100 YEAR FLOOD
- 50 YEAR FLOOD
- 10 YEAR FLOOD
- STREAM BED
- (A) CROSS SECTION LOCATION

FLOOD PROFILES

KALAMA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINC. AREA)

97P

98P

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

LEWIS RIVER

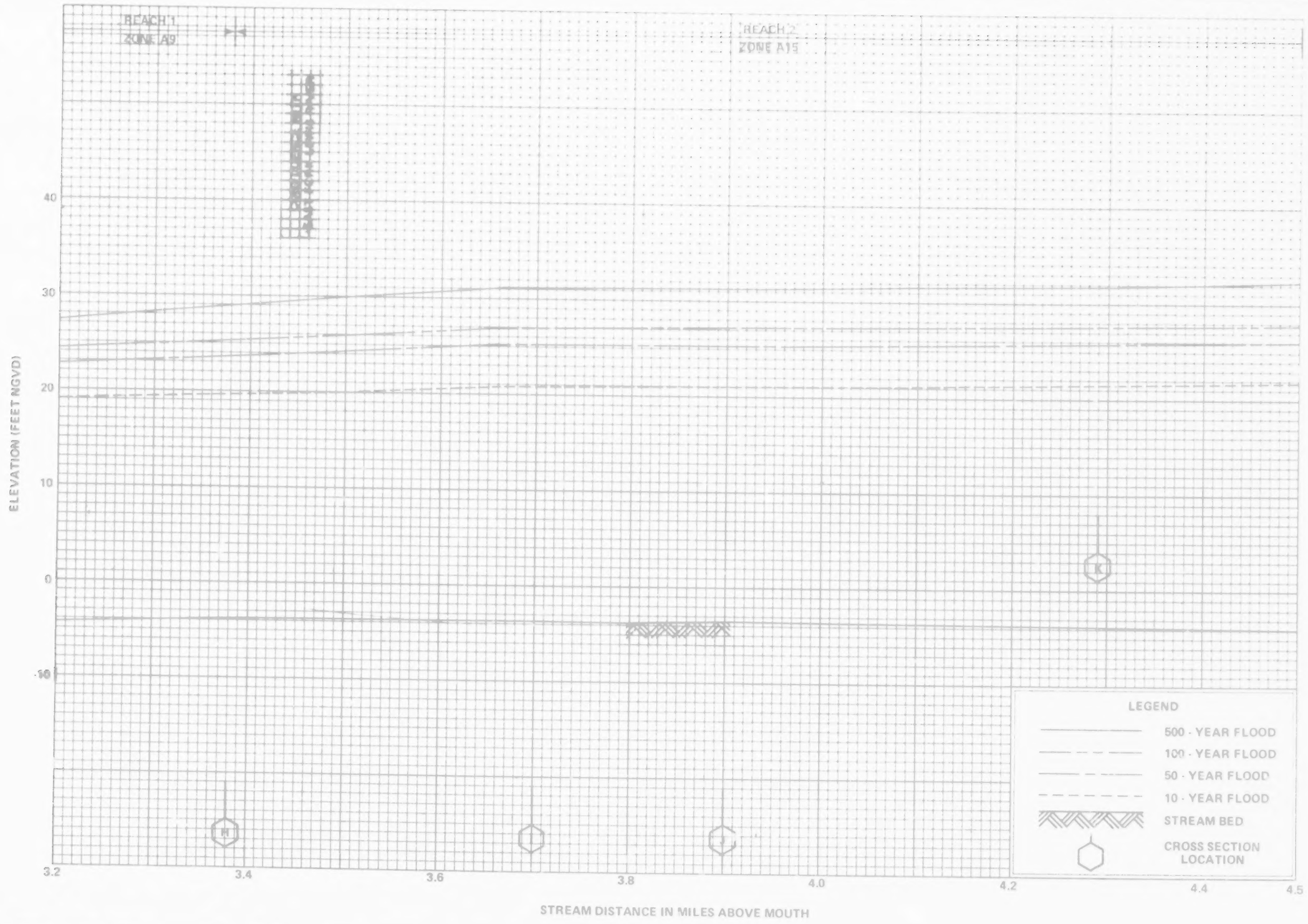
99P

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

LEWIS RIVER



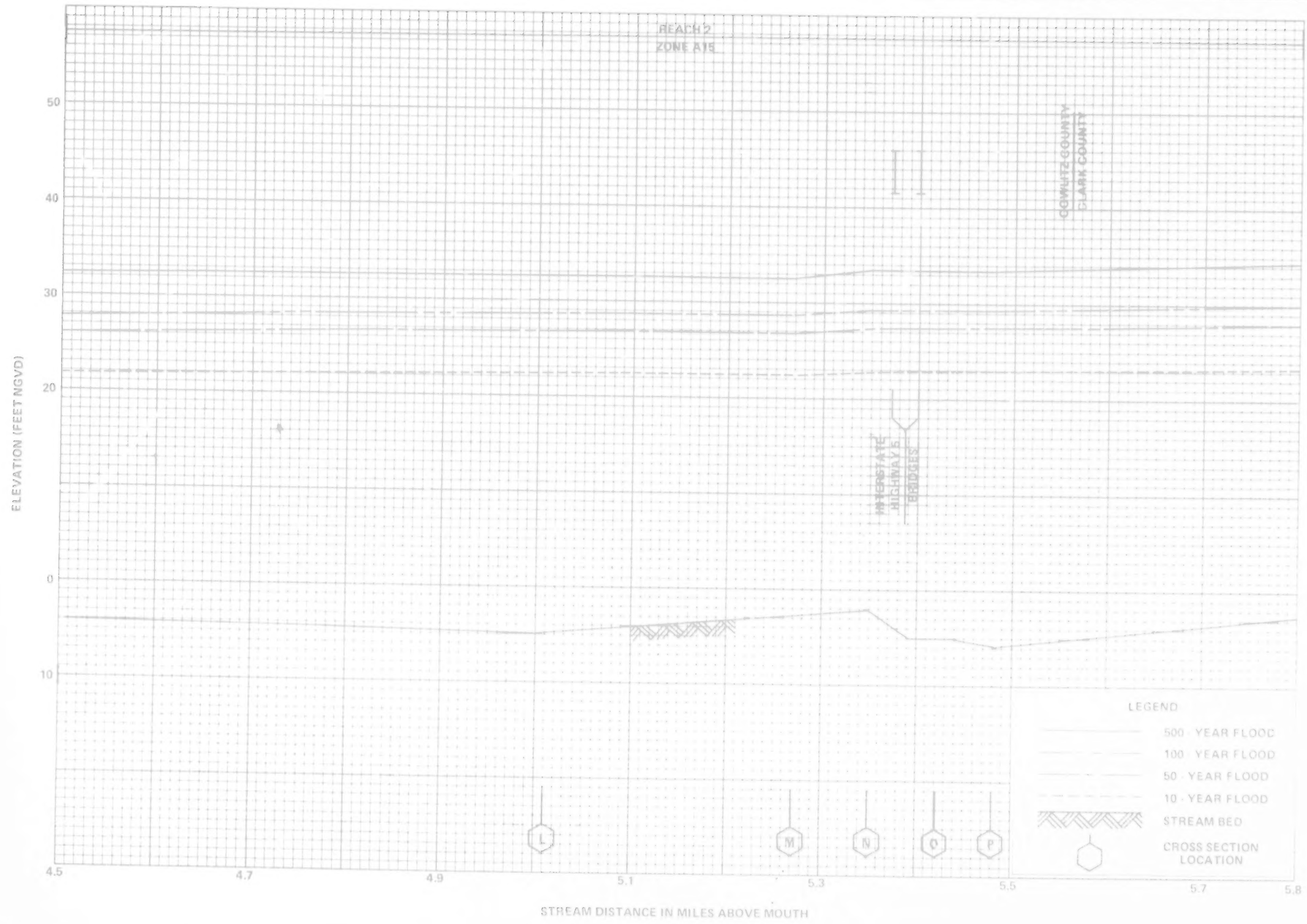
FLOOD PROFILES

LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

100P



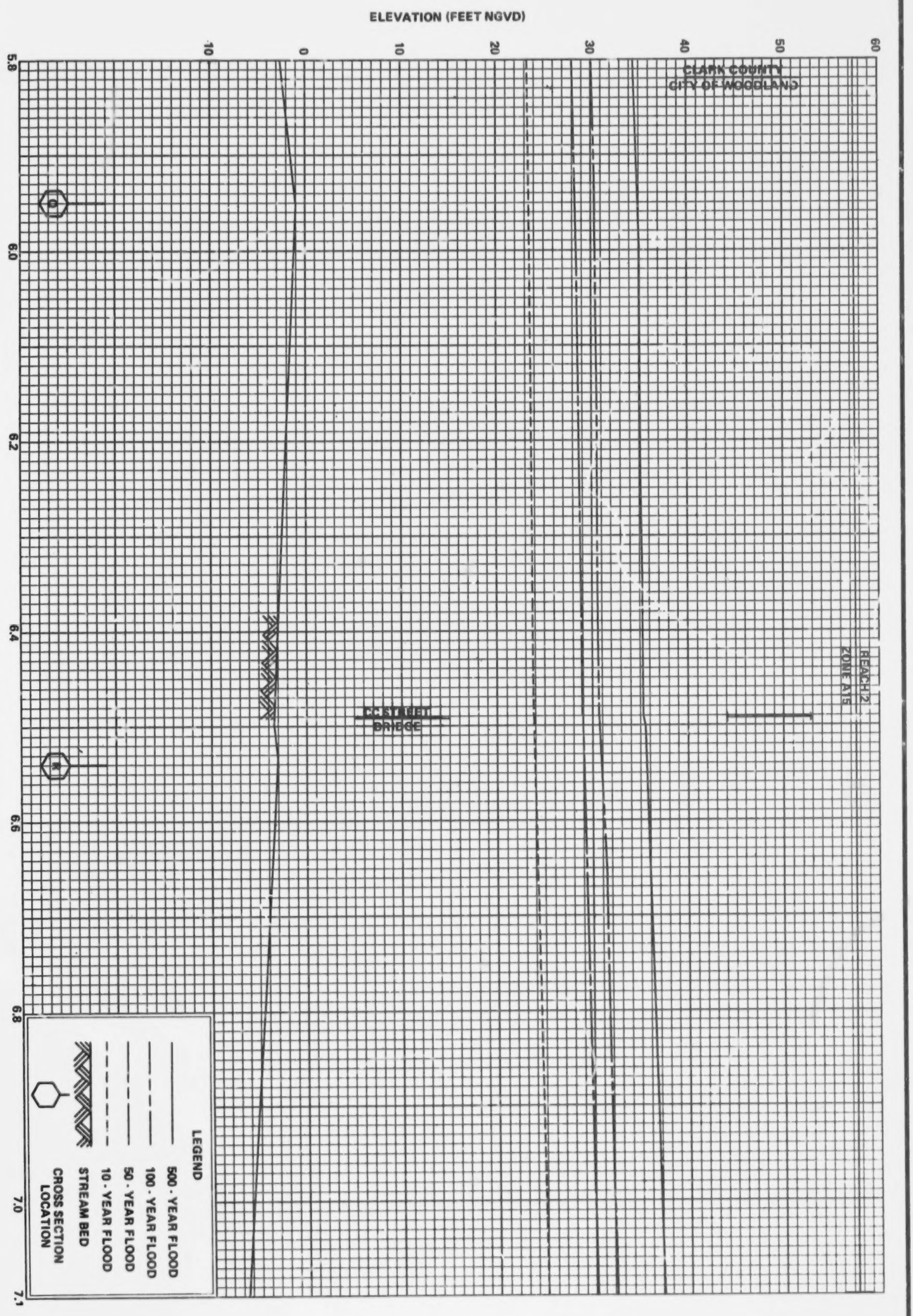
FLOOD PROFILES

LEWIS RIVER

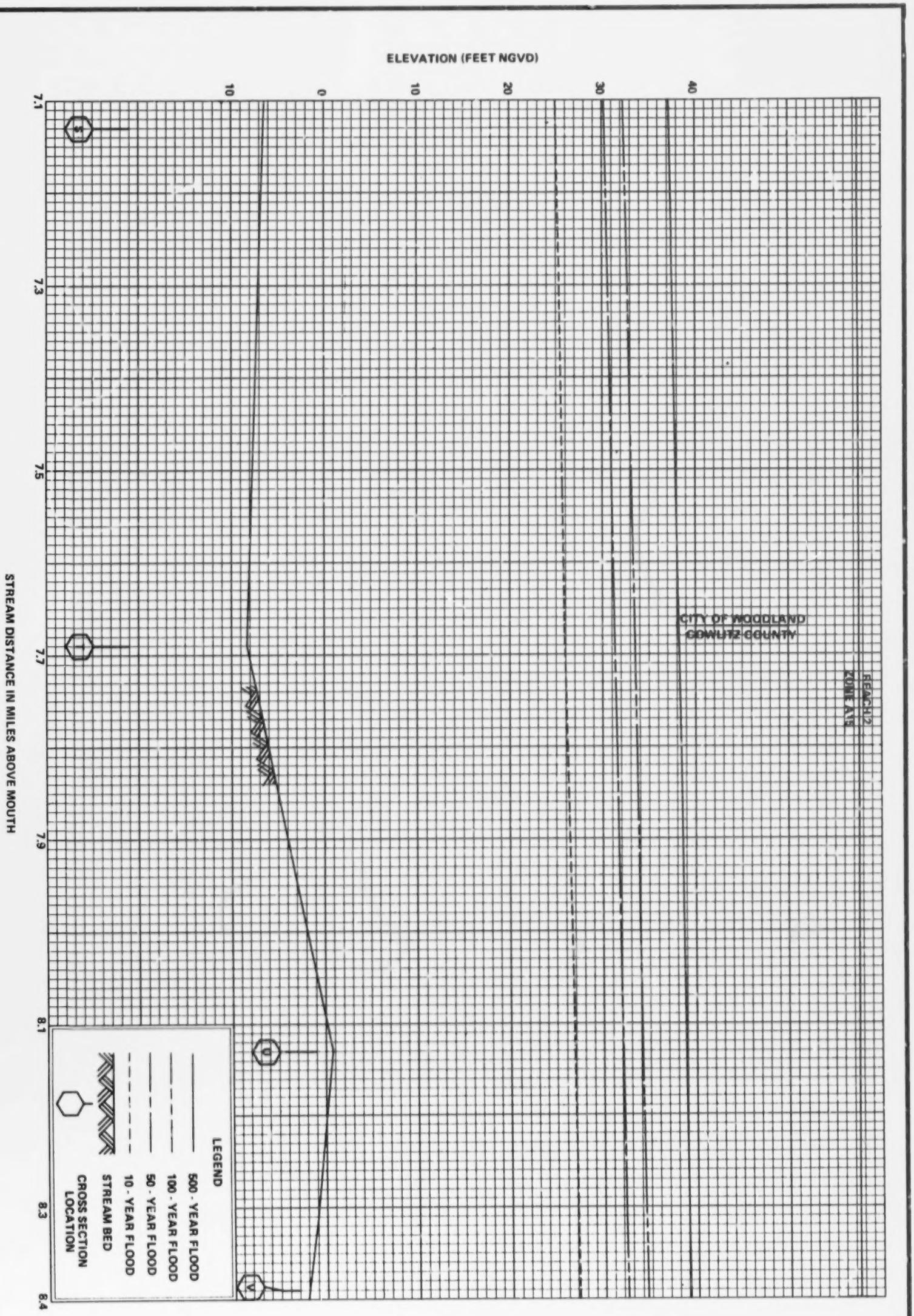
FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

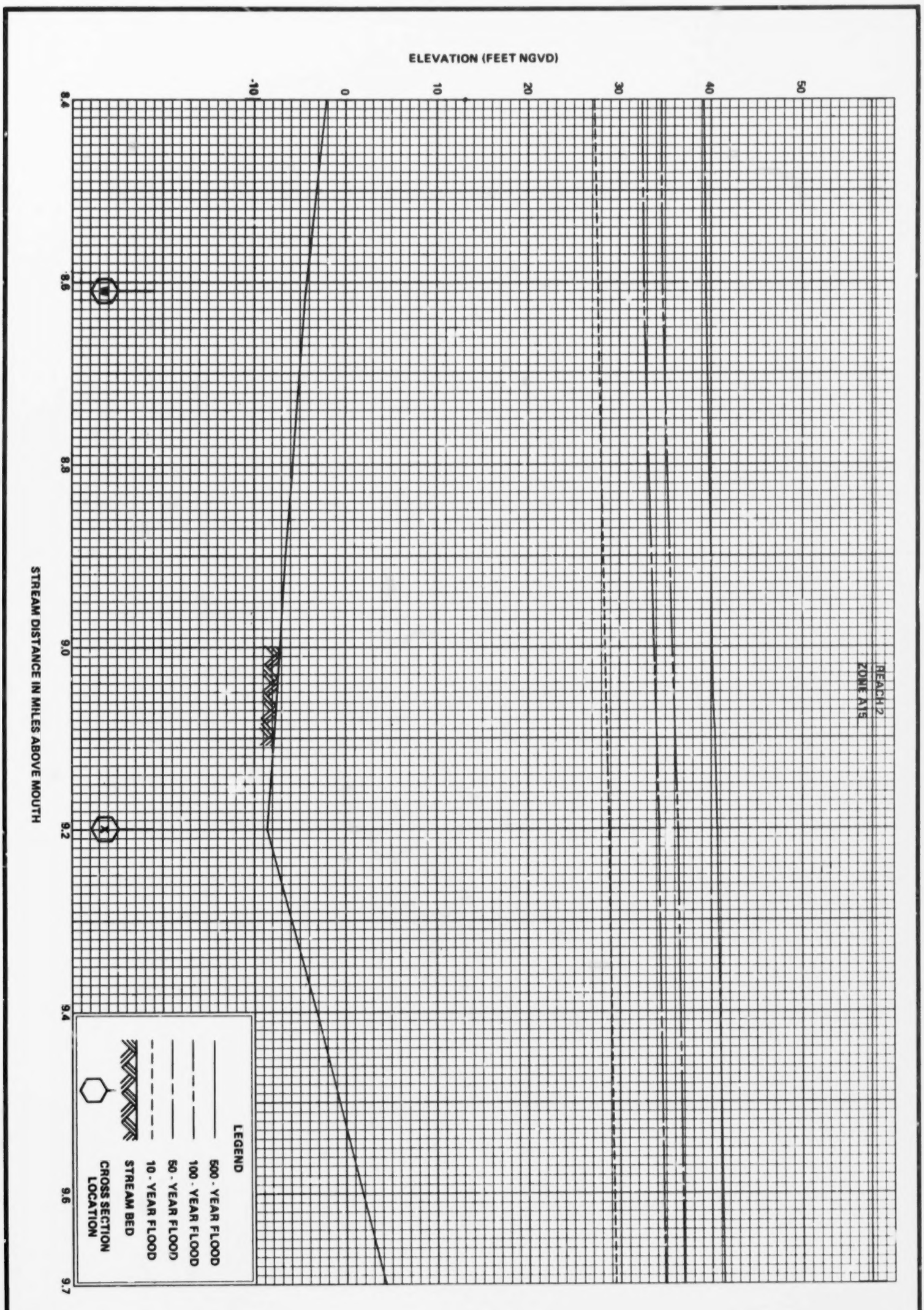
101P



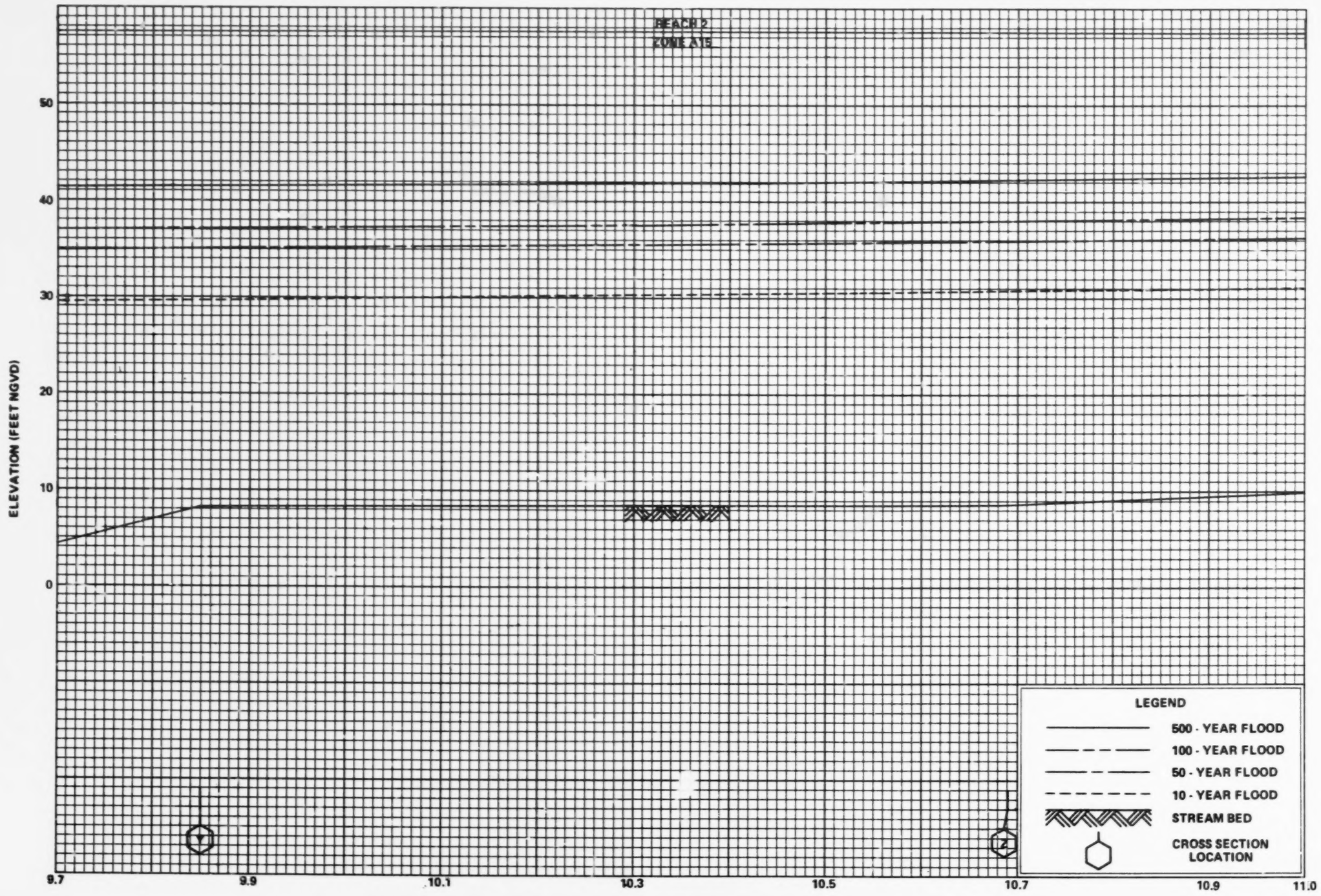
102P	FEDERAL EMERGENCY MANAGEMENT AGENCY COWLITZ COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES LEWIS RIVER



103P	FEDERAL EMERGENCY MANAGEMENT AGENCY COWLITZ COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES LEWIS RIVER



104P	FEDERAL EMERGENCY MANAGEMENT AGENCY COWLITZ COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES LEWIS RIVER



FLOOD PROFILES

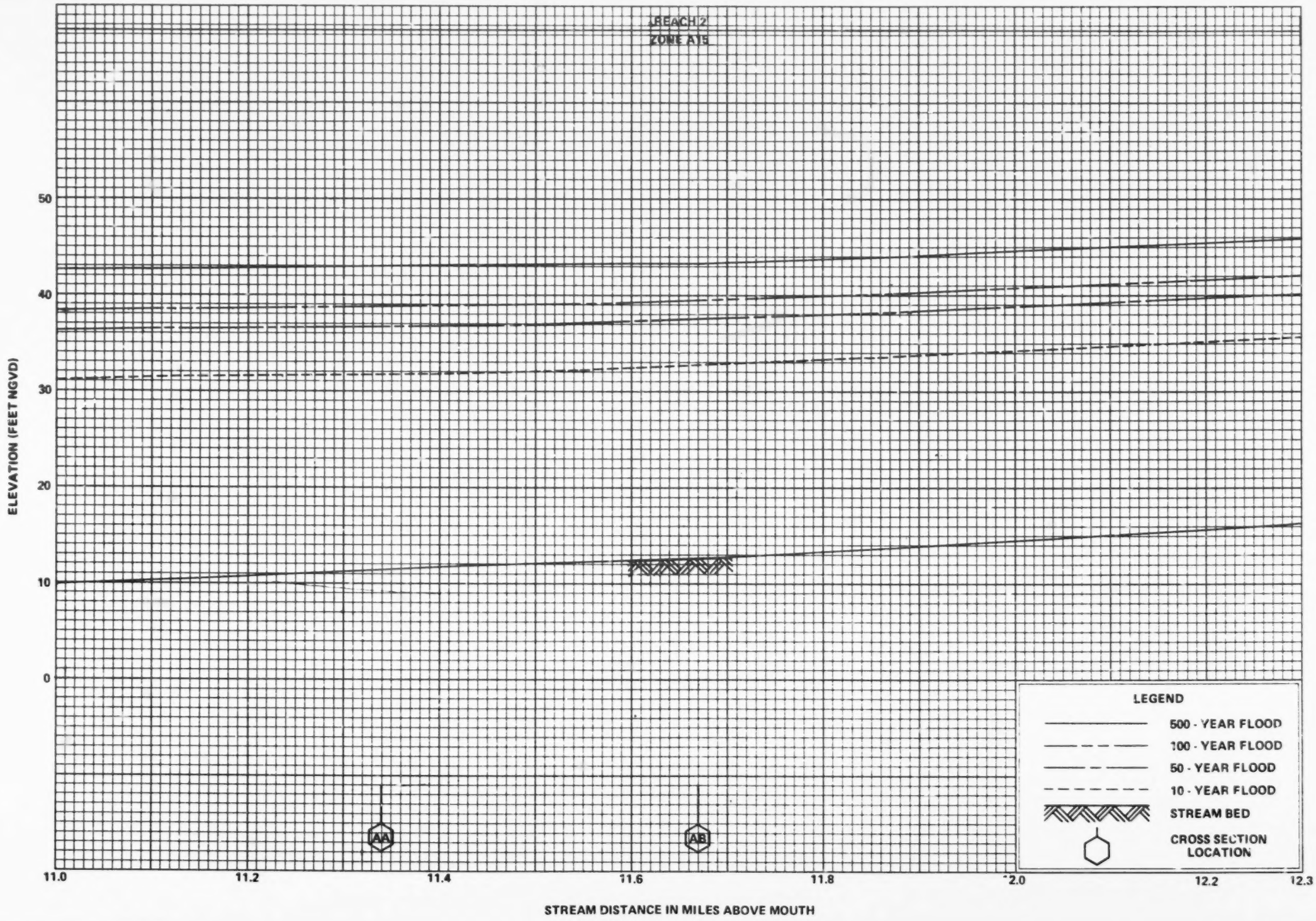
LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

105P

158



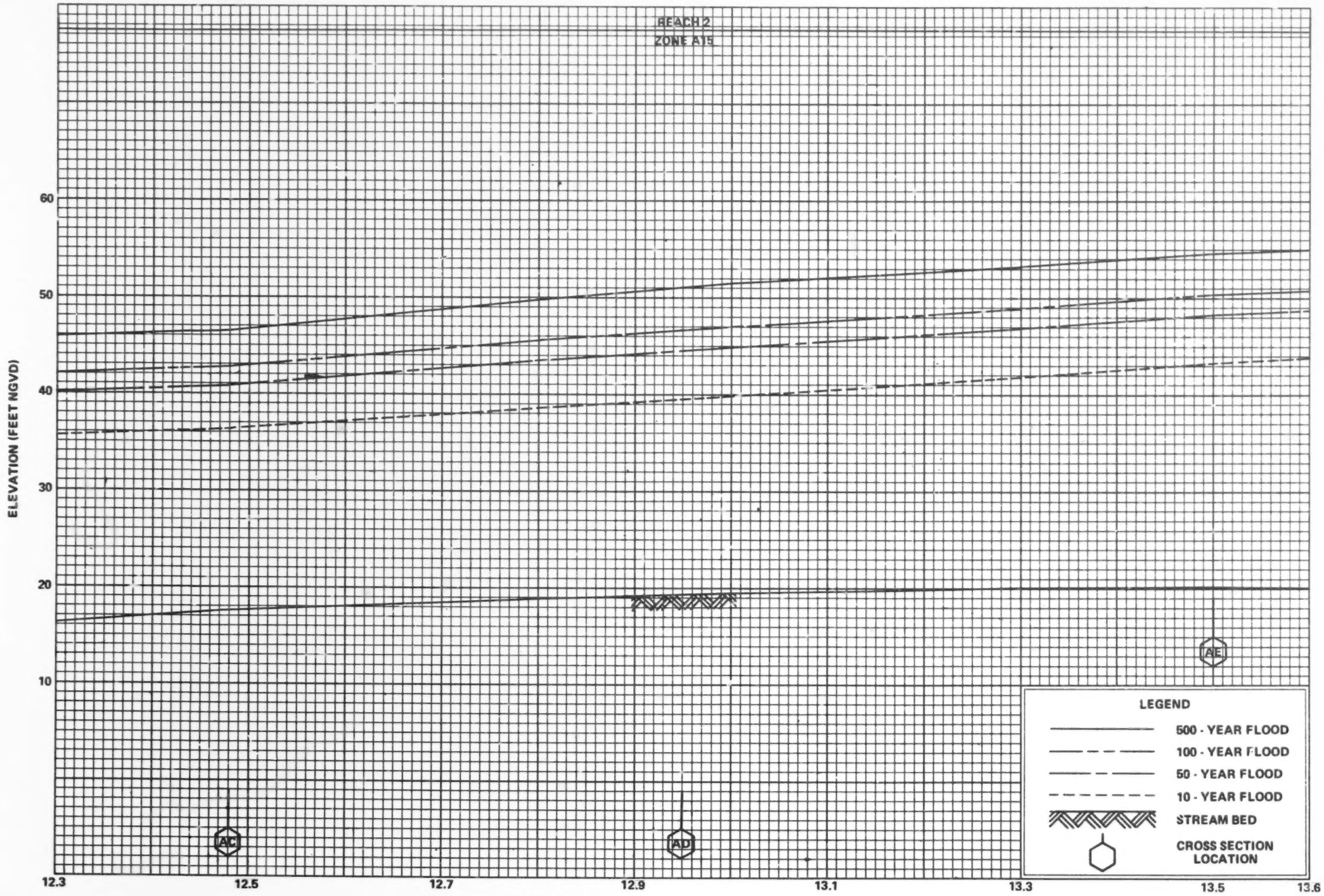
FLOOD PROFILES

LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

106P



FLOOD PROFILES

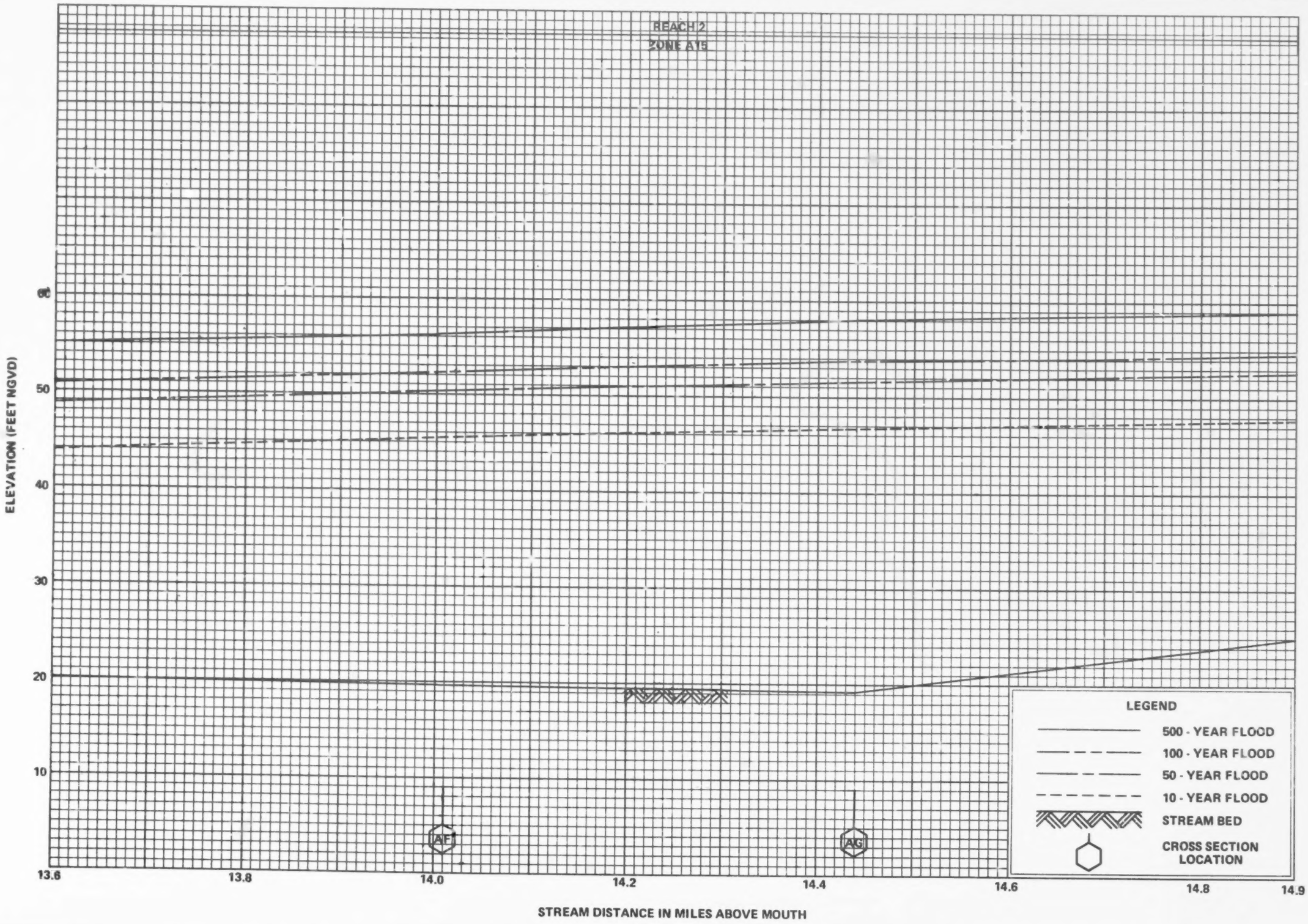
LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

107P

REACH 2
ZONE A15



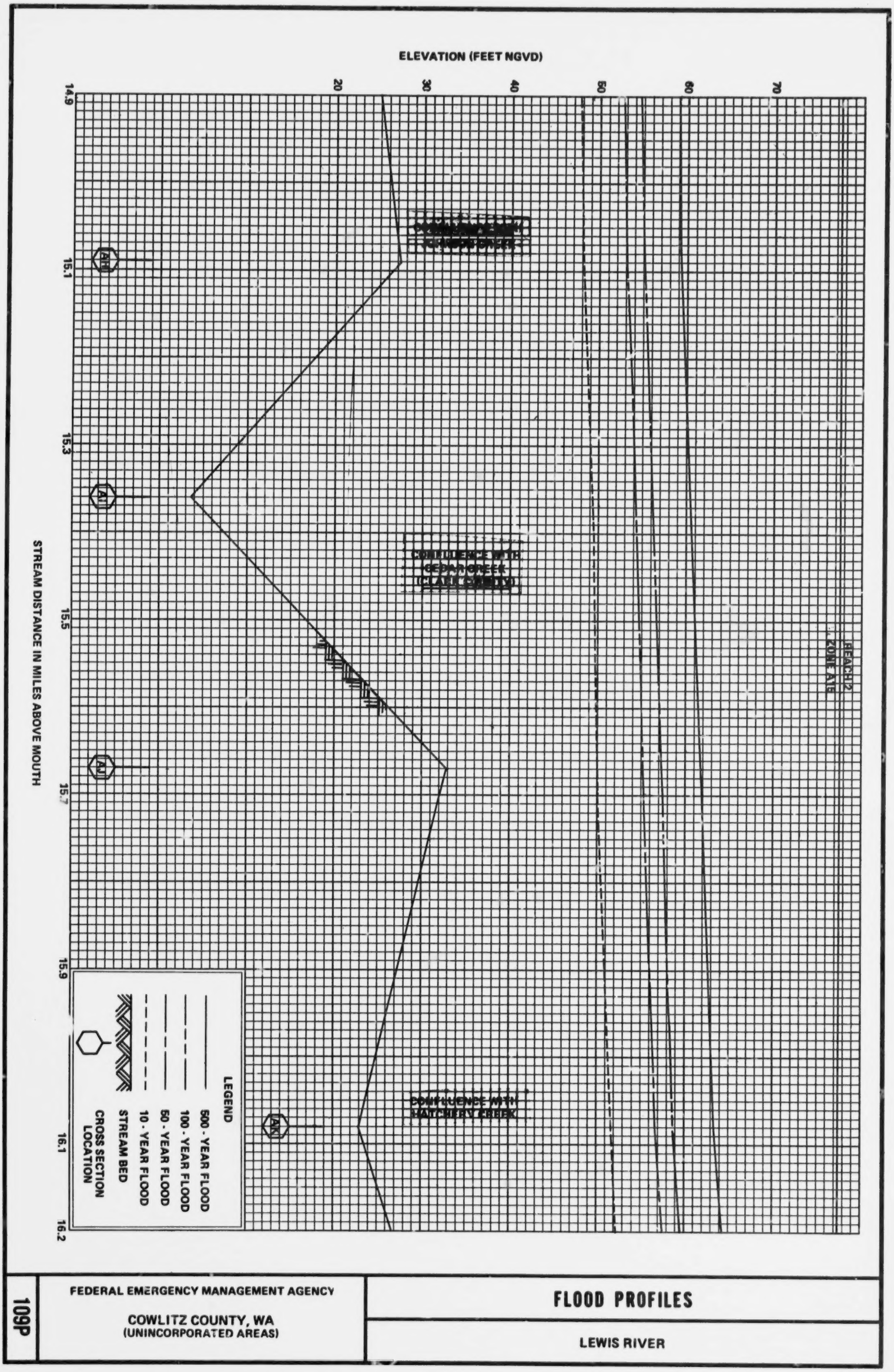
FLOOD PROFILES

LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

108P



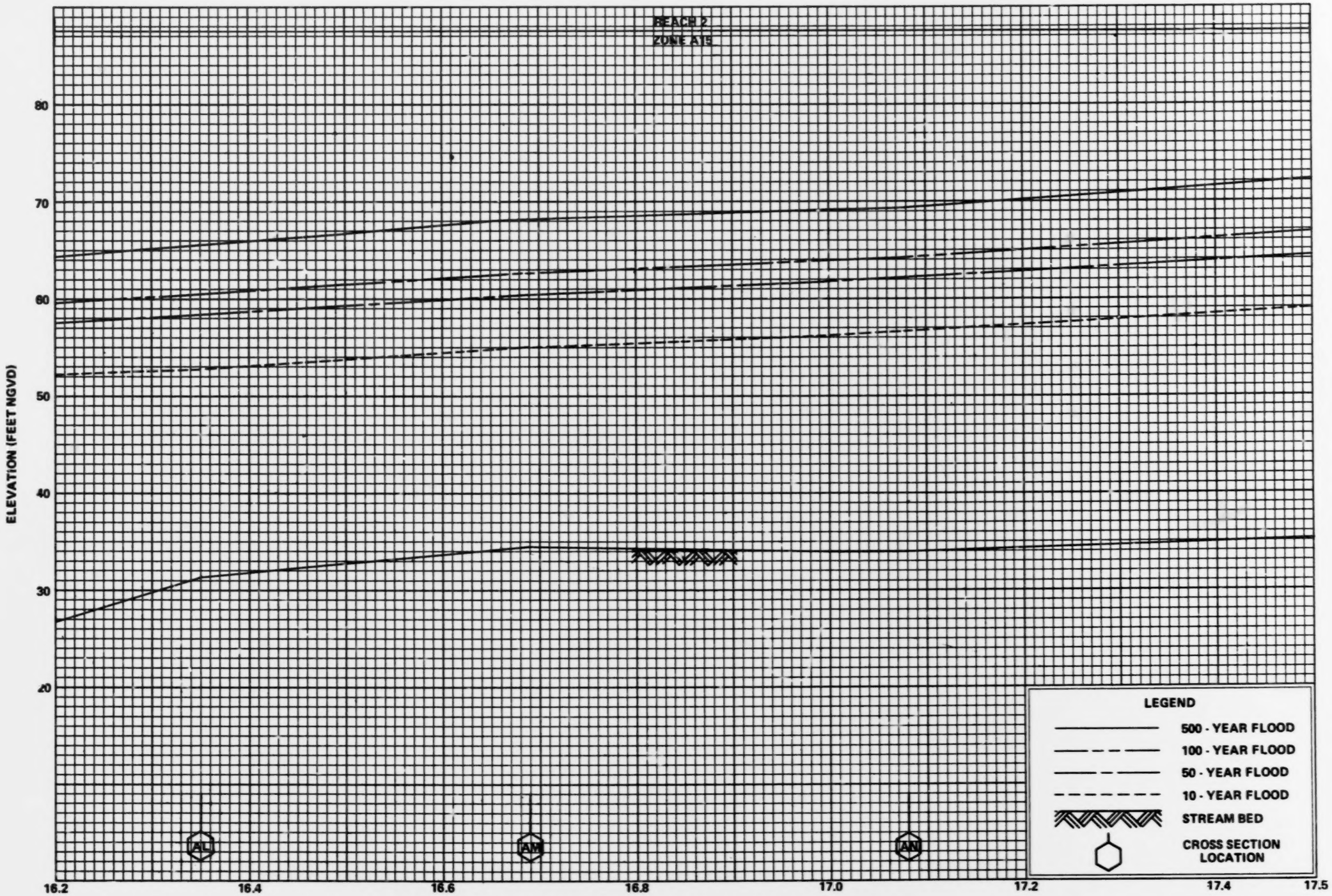
109P

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

LEWIS RIVER



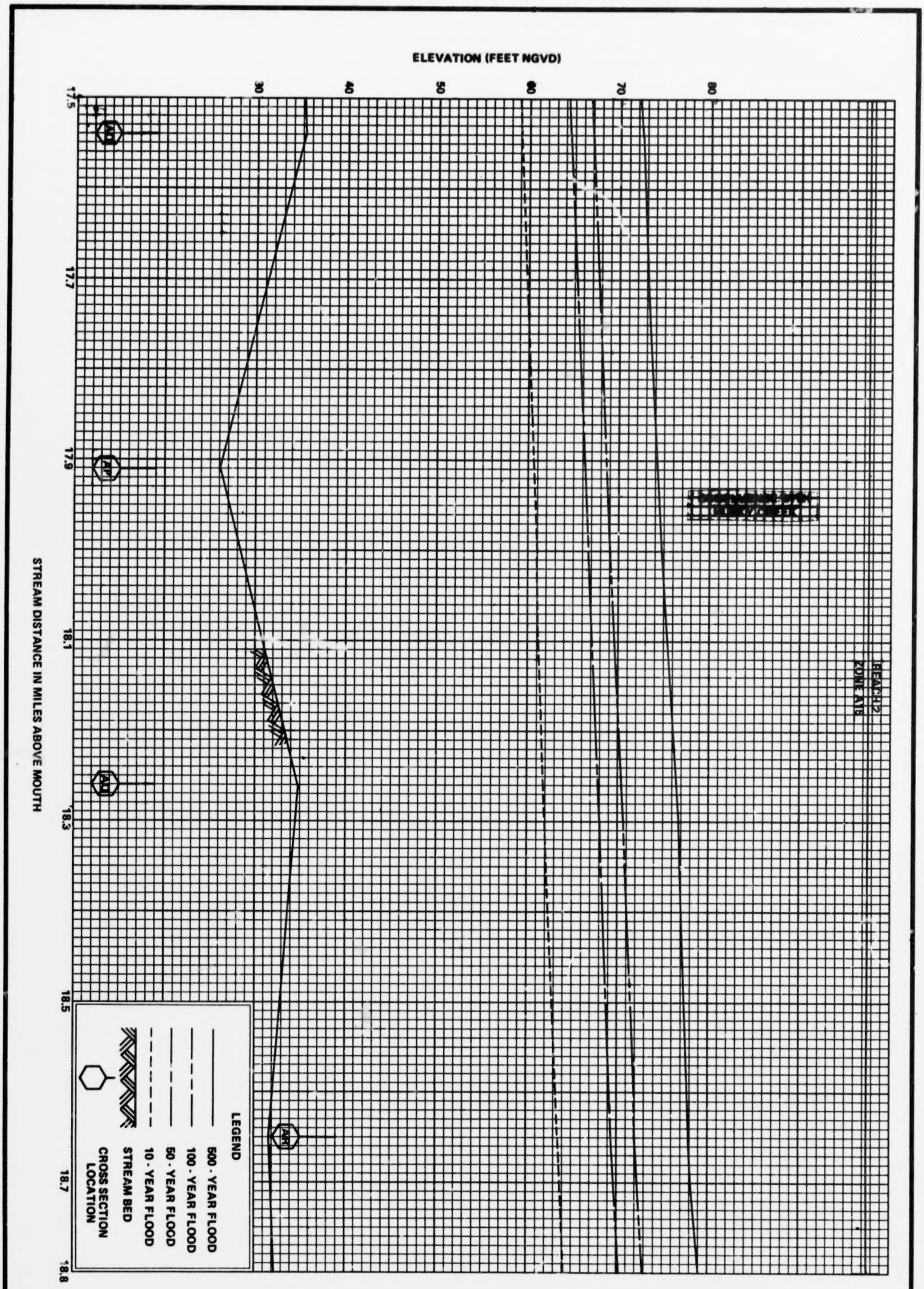
FLOOD PROFILES

LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

110P



111P	FEDERAL EMERGENCY MANAGEMENT AGENCY COWLITZ COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES LEWIS RIVER

FLOOD PROFILES

LEWIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

COWLITZ COUNTY, WA
(UNINCORPORATED AREAS)

112P